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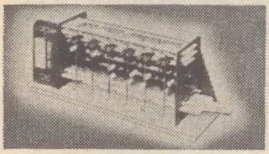

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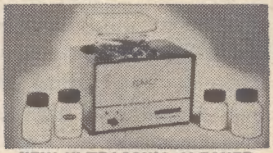

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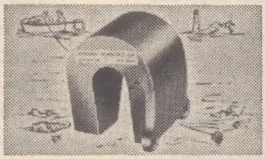

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TROUBLE with the monster business is that photo evidence is either of dubious quality or can't conclusively avoid suspicion of fakery. You'd think *someone* would get a foolproof picture of the Loch Ness monster during 3,000 reported sightings in 35 years!

Well, it's not all that simple. I was on the loch shores a month ago, watching the serious-minded members of the Loch Ness Phenomena

THIS MONTH

Investigation Bureau (S.D., Jan., 1967) scan the water through batteries of high-powered telescopes. Long lens cameras stood ready to trap on film anything that moved. This has been going on for two years. So far, no luck.

We discussed this one chilly evening before a hearthfire in nearby Glenurquehart Lodge. I asked David James, a director of LNPIB, if it was because there hadn't been any sightings. "We had a spectacular sighting this week," he said. "But it was too dark for pictures."

Next day at an observing post, Clem Skelton, LNPIB's resident technician, unglued an eye from a scope to inform me he'd seen a distinct hump that morning. "By the time we got a camera on it, it was gone," he said, shaking a head of red hair that stands as straight as though he were holding a live wire.

There's the rub. But *this* year they'll get the shot, they insist. We wish them luck. —*RFD*

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DIGEST

There is something about Easter Island, with its gigantic statues, that produces an almost hypnotic effect on men of imagination. Recently a pair of French reporter-photographers went to the island. The result is an exciting photographic record of one of the most mysterious places on earth. See page 25.

Photo from Pictorial Parade

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NEWS IN BRIEF

Bulletins at press time

MULTIMOUSE. The striped rodent pictured above has either four or five parents depending on how you look at it. It has been created from the fused fertilized eggs of a black and a white rat. The fused egg is then implanted into another female where it develops (See p. 32).

CHROMOSOME COUNT. Recently there has been a good deal of publicity concerning chromosomal defects and their possible relationship to mental abnormalities, particularly to criminal tendencies. But tests for these defects are hampered by high costs and lack of trained personnel. The cost for a test may be as much as $5,000. According to one expert there are only 200 or 300 persons skilled enough to perform the chromosome analysis properly, but probably five times as many are engaged in the analysis even though most of them are incompetent.

MARIJUANA CONDEMNED. Committees of the American Medical Association and the National Research Council, the research arm of the National Academy of Sciences have issued a joint report which calls marijuana "a dangerous drug." There have been conflicting medical and scientific opinions on the dangers of marijuana and the report is one of the strongest condemnations yet made by such agencies on the use of the drug. The report noted that making marijuana generally available would create a problem comparable to the problems of alcoholism.

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WSD8HI

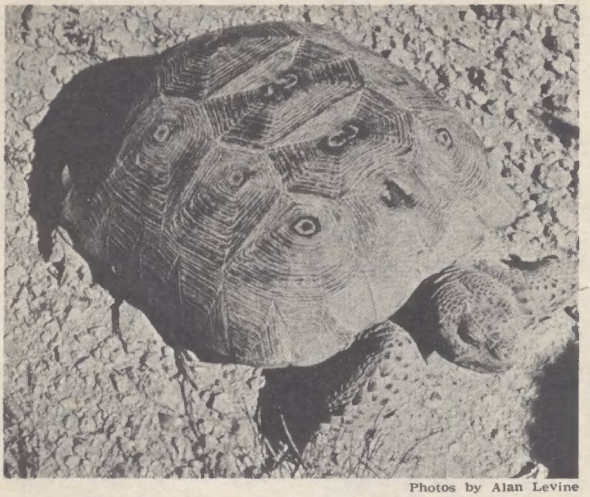
DISPUTE OLDEST MAN IN AMERICA. Dr. Louis S. B. Leakey and some of his associates have touched off a fierce controversy by announcing they had discovered human artifacts in North America estimated to be 50,000 to 80,000 years old. The find was made near Yermo in the Mojave Desert of California. While many scientists believe that there is good evidence that places man in America 30 to 40,000 years ago they are skeptical that the stones found at the California diggings really are artificially shaped tools. They argue that the stones may have been shaped naturally or that the dating is incorrect.

HOT POTS. "The man who sells vegetables in the Old City has pieces of pottery underneath the tomatoes." So says an antiquities dealer in the Old City of Jerusalem quoted in The New York Times. According to the Times a flourishing market in illegal antiquities has sprung up since last summer's Arab Israeli war. When the barriers between the Arab and Israeli sectors of the city were lowered collectors and tourists swarmed into former Arab areas looking for antiquities. Arab peasants and Bedouin tribesmen are only too happy to supply the antiquities although the sale is illegal.

CHEMICAL DIET. Laboratory rats at the Massachusetts Institute of Technology have been thriving on an "artificial diet". Some of the protein foods are produced from bacteria, yeast, algae and fungi grown in oxygen-enriched solutions of hydrocarbons made from ordinary petroleum. Other techniques involve solutions of molasses, paper mill wastes or treated sewage. Says Dr. Sanford Miller of the M.I.T. department of nutrition, "There's no reason to assume we can't produce a completely artificial diet for animals or humans. We can do it today, but it would be expensive and might not be palatable."

MALNUTRITION AND I.Q. New studies suggest that malnutrition in a pregnant woman may endanger the mental development of her child. The national Institutes of Health which announced the findings noted that the evidence is circumstantial, and the studies are continuing.

VITAMIN TREATMENT OF MENTAL ILLNESS. Nobel Prize-winning geneticist Linus Pauling has advanced the theory that some mental patients could be treated successfully by providing them with "optimum" amounts of vitamins, amino acids and certain fatty acids. Prof. Pauling believes that much mental illness is due to deficiencies of these substances that result from genetic defects or improper diet. The theory is highly controversial.



Photos by Alan Levine

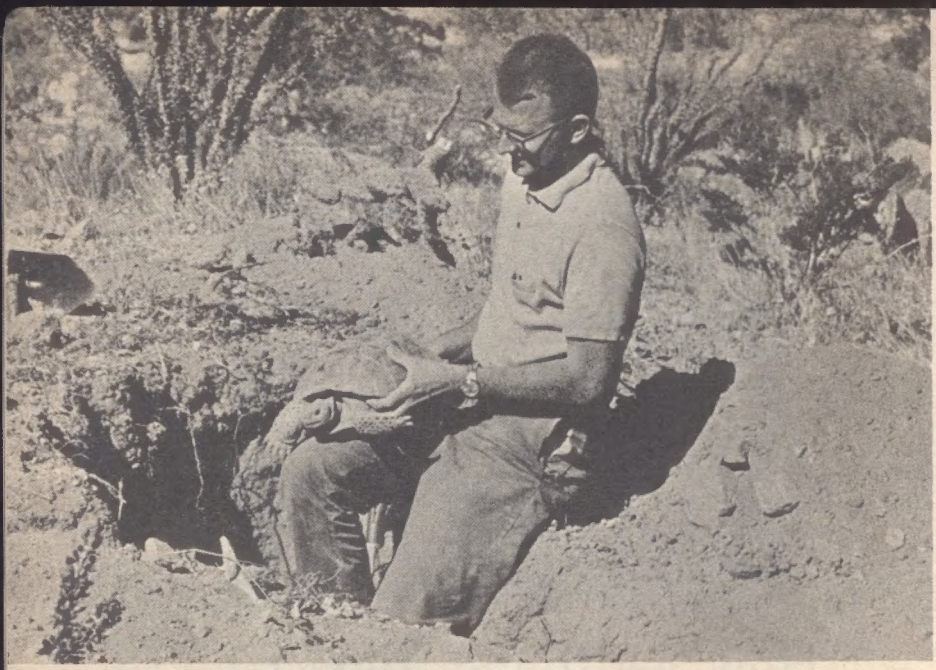
How we found Mexico's 'extinct' tortoises

It was almost embarrassing to run across this large, slow-moving and extremely o b v i o u s reptile, because science had assumed it had died out a long time ago.

by Ray Pawley

PEOPLE generally think that discoveries of new animals are a thing of the past. Today, it seems hardly possible that any sizable new creature could have escaped notice. Well, it can still happen. I was fortunate enough, two years ago, to be a member of a field group that did stumble on living specimens of a creature that, until a few years ago, had been considered as extinct as Tyrannosaurus rex—a creature whose existence, oddly, may be partially due to mankind's benevolent attitude toward it!

In late 1965, the Chicago Zoological Park, with assistance from Ted Borak, an enterprising automobile businessman, sent an expedition to Mexico consisting of myself and photographer Alan Levine. Our purpose was to gather a series of vampire bats for a new zoo exhibit. We were one of the fortunate few who were granted limited permission by—and help from—Dr. Hernandez Corzo, director-general of the Department of Conservation of



The "Tortuga Grande" or Torreon tortoise was extinct, according to zoological literature. But when scientists visiting Mexico dug down into some odd-looking burrows, they came up with a huge yellow tortoise—the "extinct" Torreon tortoise without a doubt.

Mexico, to investigate various portions of Mexico with respect to collecting some zoological specimens for exhibit and educational purposes.

A few miles from the nearest highway, on top of a small mountain, we looked across an extinct lake bed in the northern Mexico desert country. Although it was difficult to envision a vast lake at this site, we could see some evidence that perhaps our desert was "younger" than appeared. For one thing, a vanishing portion of a lake was still in view, miles away, and our vantage point may have been a shore-line a few eons ago. The characteristic giant cactus or agave of desert regions was conspicuously absent in the dry lake floor. A part-time archaeologist in Torreon had told us of Indian caves in these areas that contained quantities of discarded shellfish remains.

Later that afternoon, we discovered a striking number of large holes, or burrows, dug into the ground, all proceeding back into the hillside at a gentle slope. The amazing thing was that the entrances to these burrows were clustered in an area of half an acre or less. Though we saw no signs of the animals who made them, natives told us that they were the houses of big turtles which they called "tortugas."

The concentration of lairs seemed peculiar. North American tortoise

species are independent and scatter with their burrow sites. What kind of big tortoise would have this strong colonial tendency? Oddly, too, the burrows were not dug on the dry lake floor, nor up on the side of the hill or mountain. They were dug just above a point where the hillside *meets* the lake floor. From this location the tortoises would have to travel many hundreds of yards to the nearest food.

Did they avoid building their town on the desert floor because some ancient instinct taught them to avoid areas of potential flooding? Was their "town" so old that through the many years their natural forage had changed so that they would have to travel further from home for a meal? Why weren't there any smaller holes or burrows such as small tortoises would use? Did the young live in the adult tortoise burrows (very doubtful), or was this colony dying out? If so, was it a unique kind of tortoise not described in the books we'd read?

Since we saw no tortoises venturing about in the midday heat, we decided we would have to *dig* after one! As it turned out, this was no easy matter. The burrow was not simple and straight like that of the gopher tortoise of the eastern U.S.A., but it was branched. Every four feet or so, the tunnel would fork and re-fork, with a total of about 22 feet of tunnel work, up to six feet or more underground. It was at the terminal end of the largest fork that we unearthed our prize . . . a huge fellow with predominantly yellow color (including the iris of the eye). Its huge size (like an "overnight bag" in volumn) was unmistakable. It had to be the "Tortuga Grande" or Torreon tortoise—long "extinct" according to old literature.

As "new" animals of the Americas go, invertebrates are still being discovered and catalogued at a somewhat regular rate. Vertebrates,

"This ponderous animal wanders about in the morning or evening in full view of highway traffic. How many more undescribed species of animals remain to be seen . . . maybe in the trash-heaps of our own back yards?", asks author Pawley, with tortoise.

however, are fewer and relatively more conspicuous. In the more impenetrable tropics, new frogs and lizards as well as new birds are infrequently found, but few new mammals are being discovered. The slow-moving, highly obvious tortoise is the most unlikely candidate of all.

The New World is surprisingly short of tortoises, particularly north of the Panama Canal. The original three species of tortoise from North America (members of the genus *Gopherus*) have been known to science for more than 100 years. In spite of all this, the big Torreon tortoise (up to 10 pounds or more, and well over 16 inches long) did elude the gaze of science until only a few years ago.

Shells in the trash dump

Suspicion of this tortoise's existence had become known, we discovered, when two men from the University of Illinois discovered two surprisingly large, empty tortoise shells (carapaces) in a trash dump of a small town, Carrillo, Mexico, in August of 1958. Herpetologist John Legler visited the same desert area in September 1958, and resolved any remaining doubts when he collected a number of live specimens for study. His successful efforts led to his publication of a description of the new species in April 1959, bringing this fourth and largest species of North American tortoise to the attention of the scientific world. So—unfortunately—we weren't the first discoverers, but we were close on his heels.

How could something so conspicuous, slow-moving and widespread escape detection of science so successfully? They are found not more than 100 miles south of our U.S.-Mexico border, and at least one heavily traveled h i g h w a y cuts through a large portion of their natural range.

If the tortoise were secretive, nocturnal or hiding in a jungle, it wouldn't be so embarrassing. But, no, this ponderous animal wanders about in morning or evening in full view of highway traffic. How many more undescribed species of animals remain to be seen. . .maybe in the trash heaps of our *own* back yards?

A partial explanation may be that this tortoise is exceedingly well-known within its own natural range, but the local people never thought about it being "unknown" since it was so common! And, scientists don't always go poking around deserts asking for tortoises! Thus, due to an amusing divergence in circumstances, the two camps never made contact on the matter.

If these tortugas lived in the region at the time the lakes were at full level and the area was green, it is easy to see why this would be a choice tortoise site. However, if they successfully underwent the necessary behavior changes as their environment might have changed, the adaptability of this species is astounding. Most animals migrate to new areas the moment their environment changes even the slight-

The secret of the tortoise's survival is that man has been feeding him for years, perhaps centuries.

est bit. But to adapt from a lake area to a desert area is nearly impossible. If this is so (we still don't know), their changes have been most ingenious.

Instead of staying "topside" during the day, or most of it, these tortoises now limit their excursions to a few hours in the morning or evening to escape the scorching daytime heat or freezing night cold. Since they are remarkably active as tortoises go, they may make better use of the short available time in feeding. In fact, because tortoises can go a long time without food, they remain dormant for months at a time in the summer and winter, emerging only during a few short rainy evenings in a year!

Their ability to retain body moisture while living in their cool, dark burrows is also understandable, particularly as their skin and shell are almost impervious to moisture seepage. In fact, as do most other species of tortoises, they apparently d e r i v e their necessary moisture from the green plants they eat, storing water in a sizable reservoir in their own body for use in dry spells.

One gets the impression he is looking at perhaps the last remnants of an already relict species that should have been extinct before now. But how have they managed to "hang on" so long?

The answer may be man's efforts, and largely on a localized, uneducated level to boot!

From evidence exhibited in trash heaps dating back beyond the present Tarahumara Indians, these reptiles have long been relished as an article of diet by man. Yet, further back than anyone can remember, men would take loads of greens to the tortoise colonies, and feed the animals at periodic intervals—a fundamental practice of semi-domestication.

Nowadays, every week or so, someone will travel around with a pickup truck load of alfalfa and drop it off at the tortuga colonies. Reportedly, the tortoises come immediately to the surface and begin grazing, even b e f o r e the truck leaves the area. Here, then, is a working system of careful cultivation and cropping of an animal species that has been going on for no one knows how long. It may even be conceivable that some of the colonies would have died out except for this haphazard but helpful practice.

Much more work remains to be done with this intriguing animal. D e s p i t e the "welfare program," there is every evidence that the tortuga is on the way out. The game laws of Mexico protect the species, but it remains for research to take over, and fill in the broad gaps in our knowledge before the creatures disappear completely.

New day for

by Alfred Balk

In the harsh, dry, seemingly infinite tableland known as America's Great Plains, a dust storm is an awesome thing. There is an eerie stillness. Then the wind begins, gentle at first—then, roaring like a giant waterfall, suddenly angry and untamed. Tumbleweeds bounce across the powdery prairie like berserk bowling balls. Tiny swirls of dust appear. Within moments the sky is dark. Then the dust is everywhere — blinding, choking, turning daylight into night.

During much of the 1930s, the Great Plains were raked by a series of such storms. Towering clouds of drought-parched soil, whipped by gale-force winds, blotted out the sun for days, asphyxiated animals and humans, and eventually sifted onto Chicago, New York, Boston and even Atlantic Ocean shipping lanes. Millions of acres were eroded, and a quarter of a million penniless refugees—the "Okies" of John Steinbeck's *Grapes of Wrath*—were driven from their homes. The Southern Plains—southeastern Colorado, Oklahoma, Kansas, eastern New Mexico, and the Texas panhandle—became known as the Dust

the Dust Bowl

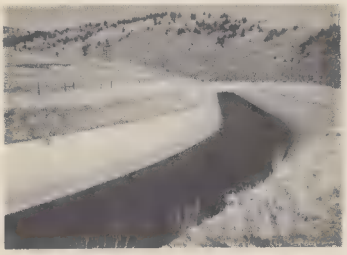
Bowl during those desolate days.

What has happened in the Dust Bowl since then?

When I visited the area recently, I found that a remarkable recovery has taken place. In some places beneath the slab-flat prairies' big sky, I saw wind-rippled dunes and half-buried fence posts—stark reminders of earlier troubles. A five-year drought has provided others: slim harvests for hundreds of debt-ridden farmers, and several gigantic dust storms that caused speculation that a new Dust Bowl is in the making. But such phenomena as these are the exceptions. Modern

The Dust Bowl, before and after. Left, a deserted barn six feet deep in sand. Right, the same barn two years later with cover crop to protect against wind, soil erosion.

South Plains trading centers such as Amarillo and Lubbock, Texas, are thriving; ranch and farm prices are at or near an all-time high; and, unlike the exodus years of the '30s, the region has a record high population, and it is still gaining. Indeed, so remarkable a conservation miracle has been wrought that when two immense dust storms blew across the South Plains three winters ago, most farmers were only



A farmer overseeds badly depleted range land (top) under Great Plains Conservation Program. Below, left, a section of a reservoir canal which fills during fall, winter and spring months from the Colorado-Big Spring Diversion, for farm use during the hot, dry summer. Below, right, water flows from a new well built with assistance of the conservation program.

mildly inconvenienced—the only serious erosion occurred in newly plowed former ranchland in eastern New Mexico and the Texas panhandle.

How has this metamorphosis occurred?

Like most great economic and social change, it neither happened quickly nor can any single source claim credit. Rather, progress was achieved painstakingly, step by difficult step, by a persistent partnership: government, science and Great Plains residents themselves.

It began in the depths of the "Dirty Thirties," while soil torn from barren fields was still forming great moving dunes and wind-driven dust filtered indoors, causing freak static electricity that rendered telephone conversations inaudible, short-circuited automobile ignitions and jolted anyone who tried to touch dirt-caked livestock. Before that, the Great Plains had been developed almost entirely by random exploitation. Millions of buffalo had been slaughtered. Native prairie grass had been plowed en masse. And, despite undependable rainfall, natural grazing land had been seeded in crops, much of it by "suitcase farmers" who came and went with the rainfall, leaving their land bare and untended during droughts. When Depression and drought followed a massive plow-up in the late 1920s, the Great Plains'

economy collapsed.

Clearly, if the Dust Bowl were to be reclaimed, more than luck and old-fashioned agricultural custom would be needed. Scientific land use and management of the highest order also would be required. Recognizing this, Congress, on April 27, 1935, created within the Department of Agriculture the largest scientific land management enterprise in history, the U.S. Soil Conservation Service. From farms, agricultural schools and other sources, SCS field men were recruited, trained and sent to the Dust Bowl by the dozens. Working with government-paid WPA laborers and Dust Bowl residents placed under contract, they began with emergency methods to halt the worst soil-blowing and level the shifting, dune-scarred land.

"We lowered dunes by building snow fences or filling burlap bags and piling them on top," says Clifton S. Etter, SCS Work Unit Conservationist in Lamar, Colorado, who was among the early waves of emergency conservationists. "At times it seemed as hopeless as moving mountains—that's almost what we were doing. But eventually the terrain began to return to normal. Then we planted an emergency cover crop. If the seed died or blew out before it rained, we planted again. It took three years or more, but finally we got the land reasonably under control."

Other specialists, meanwhile, undertook longer-term measures. They supervised planting of trees as windbreaks; designed and constructed irrigation and stockwater ponds; and introduced various special conservation techniques which are now standard among enlightened Great Plains farmers. These include strip-cropping (plowing only alternate rows for planting); contour plowing (terracing of slopes); "listing" (emergency roughing of strips of dry soil to inhibit blowing); "sweep" plowing (loosening soil from beneath rather than turning it over); and "stubble mulching" (growing heavy-stalk crops such as grain sorghums and leaving the residue as cover between plowings).

At the same time, huge areas of land too poor to be reclaimed for cultivation or grazing were set aside permanently as National Grasslands.

Recovery a slow process

For Great Plains farmers, recovery came slowly. Roy Nall, a lean, quietly capable Oklahoma panhandle farmer, recalls how during that period he and his wife taught school, annually planted a garden, tried raising chickens and hogs, and still scarcely managed to keep their farm.

A system of subsidies and incentive payments for major projects speeded progress, and farmers organized a network of soil conservation districts, administered, like school districts, by unpaid selected or appointed board members. Now numbering some 3,000 nationally, with more than 1.7 billion acres within their boundaries, the boards

survey local conservation needs and help prepare and approve coordinated plans for the landowners in their districts.

Federal farm credit programs provided a cushion against the impact of drought and other emergencies, and in 1956 Congress initiated a new, long-term Great Plains Conservation Program which includes surveying and mapping of soils by types and capability, converting low-grade cropland to other uses such as grassland, and protecting cropland from damage by wind and water.

A farming revolution

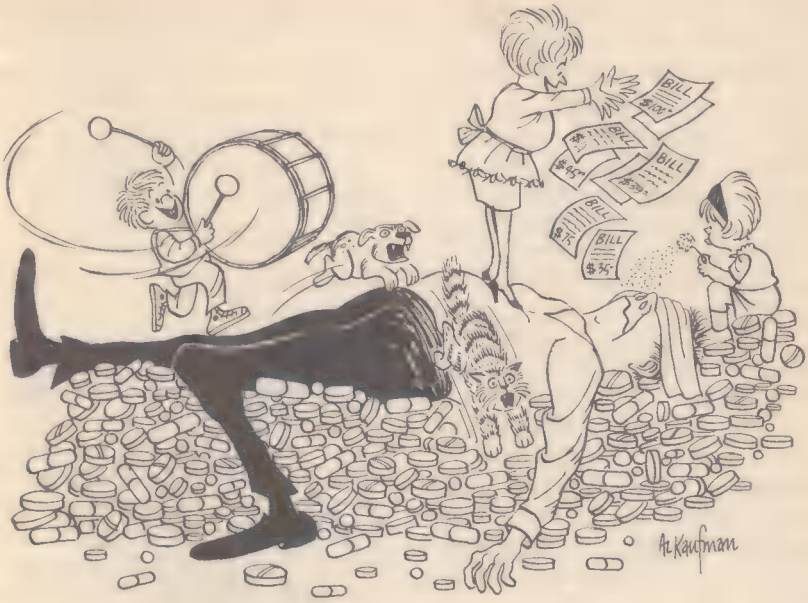
Equally important, mechanization, fertilization and irrigation techniques have revolutionized Great Plains farming methods. Farmers in Dust Bowl days depended on horses, standard plows or light tractors. Today, powerful, enclosed-cab, headlight-equipped tractors pull extra-wide "sweep plows" and other modern equipment that enables "listing" of whole sections of dry or blowing land within hours. Chemical fertilizers have made even poor soils productive, and advances in well-drilling since World War II have caused deep-well irrigation systems to mushroom. In just one area, the 42-county "High Plains" of the western Texas panhandle, 5,400,000 acres—53 percent of the cropland—are now irrigated, and ponderous, truck-mounted drilling rigs drive hundreds of new wells yearly.

For most Plains farmers, such innovations represent a staggering financial investment. Cleo Ledbetter, a big, friendly Dust Bowl veteran who farms 470 acres near Dalhart, Texas, invested in two 500-foot wells at an estimated total installation cost of $29,000. A sprinkler system and pipelines cost another $10,000, and operating both wells costs $25 a day.

"That means that in dry years I do well to break even," he says. "But it's worth it. At least I know I'll get a crop."

A visitor does not easily forget such men as Ledbetter, for in them one senses a quality vital to understanding of the South Plains. Sitting with his wife in the parlor of their comfortable home, he told me one day how he grew up in the area, got married and rented a wind-eroded farm during the Depression. Time and again he planted seed without getting a harvest. He worked as a laborer for $2 a day, spent all but his last $4 on a truck and tractor, and was ruined by a cyclone that hospitalized his wife and daughter. Yet he stayed, and eventually he prospered.

Cruel as the Great Plains can be, Ledbetter feels that he belongs there, and that this region and other ostensibly marginal ones can—and must—be harnessed for contemporary man's needs. In this indomitable faith, yoked to ceaseless economic and technological progress, one cannot avoid seeing the key to a still brighter future in America's once-desolate Dust Bowl.



America's $400,000,000 headache

by Jane E. Brody

A MIDDLE-AGED MAN came to the Headache Unit at New York's Montefiore Hospital with an unusual problem. He was suffering from recurring headaches, but his headaches "recurred" only on Thanksgiving, Christmas and New Year's Day.

A talk with the patient disclosed three factors common to his headache days: he always ate and drank a lot, his mother-in-law always came for dinner and the main dish was always turkey.

It took several years to pin-point the turkey as the indirect cause of the headaches. The patient was allergic to penicillin, and he always ate turkeys, which had been fed on mash containing penicillin.

Dr. Arnold P. Friedman, physician in chief at the Montefiore Headache Unit, chairman of the World Commission for the Study of Headaches, tells the story to emphasize that there is nearly always more to a headache than just a pain in the head.

Other experts agree that a headache is not a disease in itself, but a symptom something is wrong.

Nevertheless, Americans want quick relief from pains in the head

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—and to get it, according to industry estimates, they now spend nearly $400-million a year on remedies.

National health surveys have shown that headaches are a life-disrupting problem to more than one in 12 Americans. For some unknown reason, these surveys have found, women are twice as likely as men to suffer from severe, incapacitating headaches.

Every day, whether watching television, listening to the radio, reading newspapers or magazines or riding in buses or trains, the sufferer—and non-sufferer—is deluged with advertising advice on the fastest, surest, safest way to get rid of headaches. More than 200 analgesic tablets to relieve headaches are on the market.

Too many drugs

Their basic ingredient is aspirin—acetylsalicylic acid. But they may also contain caffeine, antacids, extra pain killers, antihistamines, vitamins or mild tranquilizers.

Dr. Friedman believes that many people take too much aspirin and related drugs, thereby masking the symptom—a headache—with pain killers instead of getting at the real trouble.

Nearly all of what is now known about headaches has been learned since World War II. Scientists, faced with vast numbers of veterans who suffered from chronic headaches following head injuries, intensified the search for what headaches were all about. The continuing studies have shown the following:

- Most headaches represent the total personality in relation to its environment.
- It is often possible to adjust one's personality and end the headaches.
- A "headache fluid" that sensitizes surrounding tissue may be largely responsible for the severe pain associated with one major type of headache, migraine.
- A predisposition to migraine tends to be inherited.

One of the main difficulties in medical treatment of headaches is that accurate diagnosis and effective treatment take time. Another major difficulty is that most headaches—perhaps as many as 90 percent—are precipitated by emotional factors, according to headache experts.

Everyone's headache is different. But, generally about 90 percent of chronic headaches fall into two major categories: the tension headache and the migraine.

Tension headaches represent reaction to stress. Usually the stress is emotional. But sometimes it is physical, resulting for example, from bad posture.

The steady pain may last hours, days or weeks. It commonly occurs on both sides of the head or in the back of the head, above the neck. Frequently it travels to the face or encircles the head like a hatband.

Migraine headaches, which experts say are also usually triggered by emotional factors, generally oc-

Stress is the usual cause of a tension headache, but purely physical reasons can also trigger pain.

cur as throbbing pain on one side of the head. They are often accompanied by nausea and vomiting.

Research has shown that the 10 percent of headaches not classified as tension or migraine have as their underlying cause some physical disease or disorder. Among such causes are inflammation of the lining of the brain, a brain tumor, infection of a cranial nerve, carbon monoxide poisoning, a sudden rise in blood pressure, a head injury and poorly positioned teeth.

What the layman commonly refers to as "sinus trouble"— postnasal drip and phlegm—rarely causes chronic headaches. But headaches often accompany acute sinus infections, which may involve severe congestion of the sinus cavities.

Eyestrain and the need for eyeglasses also are uncommon headache causes, but headaches may be a symptom of glaucoma—increased pressure in the eye that may eventually lead to blindness.

When an allergy causes chronic headaches, a runny nose and sneezing may be among the other symptoms. Allergy headaches—the mechanism of which is poorly understood—may respond to antihistamines, which counteract histamine, the irritant produced at the site of an allergic reaction.

Contrary to popular opinion, there is no scientific evidence that constipation causes headaches. But the same tension, fatigue and irregular eating and sleeping habits that can cause constipation may also cause headache.

Hangover headaches represent the body's response to the drug alcohol, which causes blood vessels to swell painfully.

Another type of headache—sometimes called psychogenic headache—represents the physical expression of an unconscious emotional conflict. Unlike other emotionally caused headaches, the psychogenic headache shows little or no physical change that can account for the pain. But, doctors emphasize, the pain is real, not imaginary.

Overworked muscles

For the 40 percent of headache patients who suffer from tension headaches, the pain is caused by continuous contraction of the head and neck muscles in response to stress. An overworked head muscle can ache just as an overworked arm muscle can. The tight muscle may also squeeze arteries and reduce blood flow through the muscle adding to the pain.

According to Dr. Friedman, the Montefiore expert, persons who get tension headaches are likely to be "highly competitive, rigid perfectionists who approach problems intellectually rather than emotionally.

"They are apt to work too hard, relax too little and worry too much about gaining the approval of others," he said. "They compulsively overload their time and talents and then overrespond to the load."

In treating tension headaches doctors may use—in addition to psychological counseling—tranquilizers that reduce anxiety and relax the muscles. Sometimes hot baths or hot packs on the back of the head and neck have a similar relaxing effect.

Tension headaches frequently occur in combination with migraine, or "sick," headaches. In migraine, the blood vessels first constrict and then expand, painfully stretching the muscles of the vessel walls. Each time the sufferer's heart beats, blood pushed through these vessels expands them further and causes the pulsing pains of migraine.

The migraine sufferer may tense his head and neck muscles in response to the pain—and precipitate a tension headache.

Recent research indicates that the pain of migraine may be largely due to substances around the headache site, referred to as "headache fluid."

These substances, among which are two miniature proteins called bradykinin and neurokinin, are believed to make nerves sensitive to pain. When the substances are extracted from the headache site and put elsewhere in the body, the person will complain of pain in the new area, Dr. Friedman said.

Australian scientists reported that the blood content of a related substance, serotonin, fell sharply at the onset of a migraine attack. Since serotonin is known to be capable of changing the diameter of blood vessels, its liberation from the blood may be an important factor in initiating the migraine attack, the scientists suggested.

A migraine attack does not start with pain but with an "aura," which occurs when the blood vessels constrict and which serves as a warning of the pain to come.

Migraine warning

In classic migraine, the less common variety, the aura is sharply defined and may include flashing lights, loss of vision, numbness or tingling, or weakness of a limb. In common migraine the aura is vague. It may involve feelings of depression or elation, gastrointestinal disturbances or swelling.

The "migraine personality" is much like that of the tension headache patient. Migraine patients tend to be ambitious, energetic, bright, methodical, punctual and intolerant of mistakes.

"Most migraine sufferers are very worthwhile people," Dr. Friedman says. "Thomas Jefferson had migraine. So did Bernard Shaw."

Headache experts believe migraines are most often triggered by emotional factors in persons whose blood vessels are predisposed to painful changes in diameter.

This predisposition is often inherited.

"If both parents have migraine," says Dr. Adrian M. Ostfield of the University of Illinois, "there is a 70 percent chance that their child will also have headaches. If one parent has migraine, the chances are about 45 percent, and if neither parent has migraine, but there is a history of it in the family, the odds drop to 25 percent."

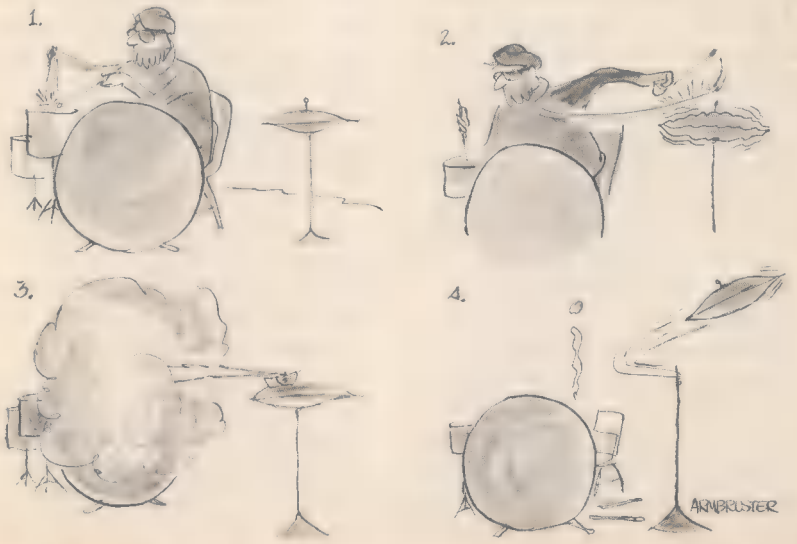
The drug most commonly used to treat migraine—ergotamine tartrate, a derivative of a fungal nerve poison—was developed more than 40 years ago. To be effective, it must be taken early in the migraine attack, preferably in the aura stage. It acts by constricting the muscles of the blood vessels, preventing painful stretching.

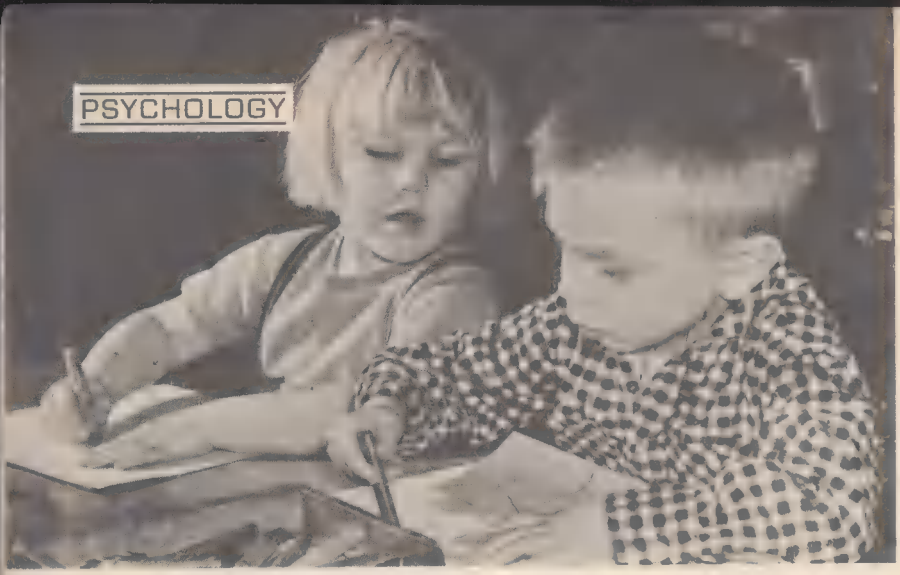
A newer drug, methysergide, also derived from the nerve poison, is effective in reducing the number and severity of migraine headaches in about 70 percent of patients. It is taken between headaches. Its exact mode of action is not yet known.

Neither drug is always effective, and both are sometimes associated with serious side effects when used for long periods. Researchers hope a fuller understanding of the nature of headache fluid will yield drugs that can intercept the pain-producing substances of migraine.

But, Dr. Friedman points out, "no matter what drugs we may develop to treat headaches, we will never find a pill that will substitute for insight into human behavior."

Headache experts have a word of advice for nonsufferers: Have understanding and compassion for headache victims—the pain that furrows their brows and shortens tempers is not just in their minds.





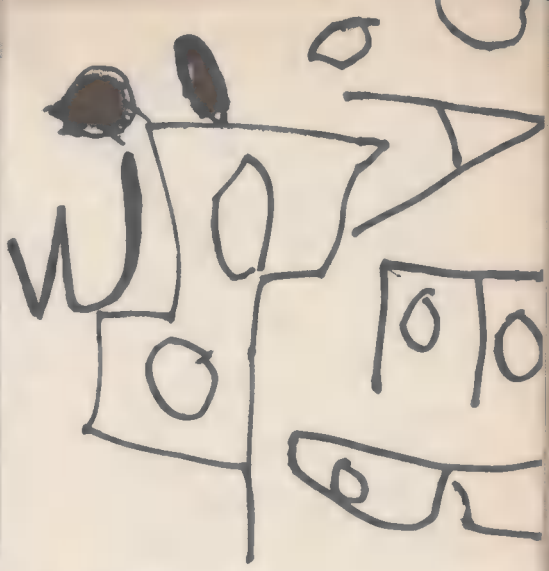
What children teach themselves to draw

by Rhoda Kellogg

MOST ADULTS find the scribblings of young children meaningless, and their first attempts to draw people, houses, animals, etc., amusing distortions of reality. At the Phoebe Hearst Preschool Learning Center in San Francisco, half a million drawings of young children were collected and studied over a period of 20 years. Results of the study turned up a number of interesting surprises.

We learned that childrens' first pictorial drawings are not efforts to depict reality. Rather, they are inventions made by modifying certain designs the youngsters have produced in their "scribble" phase. For example, all children draw ☉ before they draw ☺. One is a "design," the other is a "face," simply because adults give different labels to them—and children feel they must agree with the adult labels. Yet the mental ability and the physical dexterity needed to make either type of drawing is similar. The common adult assumption that a pictorial drawing indicates greater mental ability does not hold water.

The fact seems to be that childrens' non-pictorial drawings indicate that their minds are able to organize lines into a variety of complex designs long before they can do any pictorializing. Also, children make similar abstract designs at similar ages and in similar sequence.



Young kindergarten students in San Francisco take their artistic efforts quite seriously, as shown above. A 4-year-old girl used the letters AEBOWM to form the abstract design of her painting, at right.

Out of the more than 1,000 children who have attended the Golden Gate Kindergarten Association's nursery schools since 1953, the drawings of a sample group of 267 children were analyzed for pictorial content. All had been in school from age 38 through 44 months.

These children made a total of 103,960 drawings while in school. Their "pictorial" renderings could all be grouped under the following headings: suns, humans, animals, vegetation, buildings and transportation. Careful records were kept of each child's set of drawings, and each set was independently viewed by three of us for agreement on pictorial content. We found that children draw subject matter in similar sequences and quantities according to age level development.

The accompanying chart tells the story.

Number of children making pictorials shown by age. (267 total children).

	Age 2	Age 3	Age 4
Suns	11	146	48
Humans	9	146	50
Animals		28	56
Vegetation		25	52
Buildings		17	52
Transportation		11	36

From this sample of study, we discovered that suns and humans are the first pictorials that children make, and that both appear at about the same age. Only 59 of the children who made both suns and humans made the humans first; and of these only 12 made no sun at

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Rhoda Kellogg is executive director of the Phoebe A. Hearst Preschool Learning Center of the Golden Gate Kindergarten Association in San Francisco, Calif.

approximately the same time.

There were 58 children in the group who made none of the items listed. Of these, 45 left school before the age of 49 months. Another nine children were so little interested in drawing that their ability could not be judged by their small output. This left five children who failed to produce suns or humans when expected—based on the data shown in the charts. Of these, three had severe emotional problems which prevented them from concentrating visually on their own drawings; the other two cannot be explained.

Adults who think that only pictorial drawing provides evidence of creative intelligence are, we believe, under a serious misconception. All of the children in our test group gave evidence of normal mental capacity. Two-thirds (all whose addresses could be learned at a later date), had learned to read in school and otherwise developed according to accepted norms.

All photos Pictorial Parade

A new look at Easter Island

On the following pages are a striking series of photos taken on mysterious and lonely Easter Island by a recent French expedition.

THE LURE of remote Easter Island and its giant statues is tremendous. (See Isle of Eyeless Watchers, Oct. '67). Not long ago two French photographer-journalists spent six weeks there. One purpose of the expedition was to set up one of the island's many fallen statues.

Before they had a chance to write up an account of their experiences the two, Tony Saulnier and Hubert Herzog, were tragically killed in an airplane crash. But they did leave behind a unique photographic record.

There are two types of statues on Easter Island. Those that stand on the slopes of the volcano Rano Raraku are the ones pictured on the preceding page. They are the most commonly photographed because they are still standing. But there is a second type of very similar statue. These are called *ahu* statues because they once surrounded the burial enclosures called *ahus*. The *ahu* statues were more complete than those on the volcano slope, and there is speculation that the slope was merely a storehouse for unfinished statues. When needed, they would be dragged to the *ahu*, and the finishing touches would be added. The quarry in which the Easter Island statues were carved lay farther up the slopes of Rano Raraku.

Left: During the smallpox epidemic that hit the island, dead were buried in unmarked mass graves, which are even now occasionally unearthed. Center: Crane plants "hat" atop re-erected statue. Above: All those who participated in the statue raising, pose with pride. Tradition dictates that statues must face inland.

When the first European seamen visited the island in the early eighteenth century, the *ahu* statues were still standing. But between the time of these first occasional contacts and the time regular contact with the island was established, every last one of the *ahu* statues had been thrown down and broken.

In the years between 1722 and 1800 the island was swept by unusually severe intertribal warfare. The early visitors had been charmed by the Easter Islander's apparent friendliness and high spirits. But they were also disconcerted by their unpredictable tempers. For all their friendliness, the people of Easter Island were cannibals, and easily roused to a fierce and almost insane rage.

Warfare on the island was common and the war usually ended when the losers were hunted down and eaten.

Legends on the island speak of a great war between two groups of islanders, "the long ears" and "the short ears." The short ears won, virtually, annihilating the long ears.

Raids by slave ships from Peru and a smallpox epidemic just about finished the island off. Population sank to a handful.

The shattered survivors of the series of catastrophies had only garbled recollections of their past. An English archaeological expedition which came to the island in 1914 only found a few old men who could still remember tales from "the time of the overthrowing of the statues."

Remembering the fury to which Easter Islanders could be roused, most authorities agree that the statues were probably overthrown during the wars. Under normal conditions the *ahu* was a very sacred place. To destroy the *ahu* of your enemy's family must have been the supreme insult.

Just exactly what the statues represented is not known. But similar groups on other islands often carve statues to be used in a burial ritual. These statues are usually of wood, and not nearly as large as those of Easter Island, but Easter has no trees, and the people seem to have done everything in a grand manner. Without wood they carved their statues from the soft volcanic rock and they made them bigger than the statues erected by any other Polynesian people.

One of the things Saulnier and Herzog wished to accomplish was to restore one of the fallen *ahu* statues to its original state.

The Easter Islanders themselves had used ropes and levers to raise the enormous statues. It was a laborious task, which could be made much easier through the use of modern machinery.

One problem in restoring the statue was that it had once been surmounted by a "hat" or *pukao* of red volcanic material. The hat is thought to have represented the peculiar top-knot of hair that the Easter Island men once wore. The hats were separated from the statues when they were tipped over, and the "hat" from this particular statue had disappeared.

So a contemporary Easter Island sculptor undertook to make a copy. Using only a stone chisel, he painstakingly carved the hat out of a block of red volcanic tuff. The job took him a month and a half.

An American military base on the island and a Chilean company that was building an airport provided the heavy equipment to raise and rotate the giant statue, set it up on its base and crown it with the five ton *pukao*.

We will probably never know just exactly what possessed the people of Easter Island to build and destroy in such a passionate frenzy. But at least we now can see what their most famous artifacts looked like.

Top: When the quarry in which the statues were made was abandoned, the workmen left unfinished some of the largest statues ever carved on the island, far larger than any of those actually erected. Left: The natives of Easter Island could raise the statues with ropes and levers, but an International Harvester crane is easier.

1. View of Easter Island from the sea. 2. Natives imitate ways of their ancestors by carving stone with stone tools. 3. Man sits inside abandoned stone "hat" which once perched atop a giant statue. 4. The crater of the volcano Rano Raraku on the

eastern end of the island. This is the principal volcano of this volcanic island. In the foreground some statues still standing on the volcano's slope can be seen. 5. Abandoned statues in the quarry at Rano Raraku. Work at the quarry seems to have ceased abruptly. Workmen's tools were found just where they had been dropped. 6. Archaeologists survey abandoned site of **ahu**, to prepare for setting up fallen statue. Current islanders have no special feeling for the enclosures.

Science Month

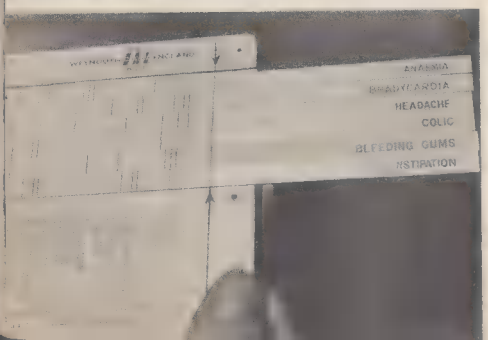
Animal marriage bureau

"YES, WE HAVE a delightful little female registered who's looking for a mate. I suggest you contact Regents Park Zoo."

A funny place for a date to live? Not if she's a rare animal. The Federation of Zoological Gardens, a British organization, has suggested a "marriage bureau" for animals. The marriage bureau would actually be a central registry in which captive animals of a particular species could be matched with animals of the same species in another zoo or collection.

This giant slide rule from England is used to aid in diagnosing diseases. By inserting symptom strips in the rule, a probable disease can be tabulated quickly.

BIPS



Many captives need mates, the Federation points out, but unless they're spectacular creatures like gorillas or pandas, they aren't likely to engender enough publicity to locate their opposite number. The group expresses concern for shy, retiring animals, particularly of endangered species. Beasts like these can be bred in captivity, then returned to their original habitat when local conditions improve. The idea has already worked with the wild horse, the buffalo, the Hawaiian goose and a few other creatures.

Of course, there may be snags even in an animal marriage bureau. Some animals adapt to captivity, eating well and taking a mate. Others appear to lose interest in sex. Remember Gargantua and Toto, the gorillas? Gargantua's captors provided him, at great expense, with a young female gorilla but Gargantua detested her. More recently, a male panda was indifferent to a female who'd been flown thousands of miles to meet him.

Such animals may not really be indifferent to sex, an animal psy-

NASA's Langley Research Center in Virginia is conducting tests on plane take-off and landings on pavement that is grooved. At left, the plane is resting on water-covered pavement. Above, the airplane is landing on the water-covered pavement. Instruments aboard the aircraft will record braking effectiveness of the plane.

chologist pointed out not long ago. They simply prefer their keeper to their natural mate. Heini Hediger, director of the Zurich Zoo, describes a five-foot-high shoebill stork who barely acknowledges the presence of a female acquired especially for him, but lavishes all the shoebill signs of affection (clapping of the bill, gulping noises, lowered head) on his caretaker. In other cases, an animal may regard his keeper as a rival. A male lion watches benignly as a keeper strokes a lioness—unless the lioness is in heat. Then the male roars menacingly and acts as if he's ready to take the keeper apart.

Tortoises, pigeons, otters, and penguins are other beasts who have courted their keepers, Dr. Hediger says. Occasionally animals act this way even toward strangers. A repairman who was crouching in the cage of an emu, a huge, ostrich-like bird, suddenly found himself the object of an embarrassing display of affection by the bird. And tortoises at Zurich University, where Dr. Hediger is a professor of animal psychology, have fallen in love with the shoe of their keeper.

Device finds buried god

A battery-operated magnetic detection device may save archaeologists a lot of digging in the future.

Yale Professor of Anthropology Michael D. Coe used a lightweight

A member of the Yale University archaeological expedition in Mexico uses the new cesium magnetometer that has helped uncover the nearly perect Olmec rain god, at right.

cesium magnetometer recently at an Olmec site in Mexico and unearthed four outstanding monuments in a few days. The device indicated that up to 500 more monuments are still hidden below ground at San Lorenzo, the political center of the Olmec civilization. Before using the magnetometer, Prof. Coe had estimated that only several hundred more monuments remained. He had already extracted 48 significant ones on two earlier trips (See *Science Digest*, September, 1967).

The new finds include a smooth upright ceremonial slab, the back part of a helmet from a basalt head, a 10-ton oblong block denuded of its designs with axe blows, and what Prof. Coe calls "the most perfect statue ever found at San Lorenzo of the Olmec rain god." The three-foot high statue is complete except for its hollowed-out back. Most statues at San Lorenzo had their heads knocked off in the violent internal conflict that took place between 1000 and 900 B.C.

Earlier models of the magnetometer have been used for archaeological work, but the results are not as clear cut as at San Lorenzo. At the Olmec site, the basalt monuments were buried under hundreds of tons of rock fill of quite a different composition than the basalt. The magnetometer had no trouble distinguishing the basalt and designating its location.

Designed by Varian Associates, the magnetometer works by determining the variations in the earth's magnetic field. A similar device located the sunken submarine Thresher in 1963.

It's multimouse!

The birth of the latest "multimouse", a striped female mouse with two fathers and two mothers, has been announced by North Carolina State University. The mouse will help researchers unravel some of the mysteries of the gene (see "Man the Creator", *Science Digest*, March, 1968).

One side of the multimouse's face is white, the other side dark. Alternating bands of white and dark hair cover the rest of her body. Even her whiskers are white on one side of her body and dark on the other. As a further proof of her mixed heritage, she has given birth to both white and dark mice after being mated with a white mouse.

North Carolina's multimouse began with the separate mating of a pair of white mice and a pair of dark mice. The resulting embryos were removed from the females when they were two days old and put together until they became one small cluster of cells. The cluster was implanted in a third female. Nineteen days later, the multimouse was born.

Scientists have bred hundreds of multimice with this method, which was developed by Dr. Beatrice Mintz of the Institute for Cancer Research in Philadelphia. Dr. Mintz says that multimice make it possible to study the effect of genes in a way that isn't possible with animals that have only two parents.

She has traced the patches of different colored hair on multimice back to the original cells containing genes that determine the hair color. The process in which the genes select hair color is extremely orderly, she says. Multimice can be bred for any number of characteristics.

Beam digs tunnels

A powerful beam that melts rock like a hot knife melts butter is being developed by a Westinghouse scientist, Dr. B. W. Schumacher. The instrument shoots out a narrow beam of electrons a few inches long that looks like a white hot needle. The beam quickly penetrates as deeply as four inches into rock when the device is a half inch from the surface. Its uses? Digging tunnels, trenches, quarries, and mines says Dr. Schumacher. It might be particularly good, he thinks, for digging up city streets quietly.

A clean swim

Swimmers in areas with polluted waters may be able to get a sanitary dip after all. The city of Cleveland

Modulated laser beams from this argon laser have sent messages to a geodetic studies satellite as part of a NASA program to develop a communications system for the future for long distances.

is building chlorinated pools in Lake Erie, the waters of which are too polluted for swimming, and a private foundation in Stamford, Conn., is setting up a pollution screen in the waters off Southfield Beach.

Cleveland's project involves building plastic vinyl barriers between existing jetties, and leaving the beach side of the enclosure open. Then lake water is pumped out and chlorinated city water pumped in. Not all pollution is eliminated by the vinyl wall, the city administration admits, but the water should be safe enough for swimming.

The first Lake Erie pool was scheduled to open this summer and a second, larger one is due the following year.

In Stamford, three perforated pipes will be set up 100 feet off the beach. Connected to a compressor on shore, the pipes will throw up an air barrier that not only will keep out floating debris but will introduce oxygen to increase the decomposition of human waste and accelerate the production of benevolent bacteria. A laboratory in the compressor house will analyze water samples.

Stamford's plan will cost about $30,000 without the laboratory, it's estimated, while Cleveland's project got a low bid of $129,000 in the spring. The city fathers hoped to lower the bill.

Long-lived scientists

What's the best way to attain a ripe old age? Rock on the front porch of a house in a quiet country town? Not at all, say Metropolitan Life Insurance Company statisticians. Become a scientist. A 12-year study shows scientists have a mortality rate 20 percent below the average for males listed in *Who's Who in America*. College teachers and clergymen are 10 to 15 percent below the average. The group with the least favorable death record is men of letters, whose mortality rate is 30 percent higher than average. On the whole, though, men listed in *Who's Who* have a death rate 30 percent below the average for white males in general.

Timber bamboos at USDA's station in Savannah, Ga., tower over visitors. Some timber bamboos reach 120 feet, while other species are low enough to be mowed.

Bamboo—the big grass

by Barbara O'Connell

IF YOU STAND in a grove of trees near Savannah, Ga., on a quiet spring day, you'll hear a strange cracking and tearing sound. The trees are bamboos planted by the U.S. Department of Agriculture. The noise is the protective sheaths ripping away from the stems as the bamboos shoot upwards at the rate of as much as an inch every forty minutes. In a single day during the spring growing season, the big timber bamboos may grow three feet.

Bamboo grows sideways almost as fast as it grows up. If you examine the roots of the aptly-named "running" variety of bamboo, you'll

see a segmented root system that travels parallel to the surface, sending up a shoot every six inches or so. The roots travel so speedily that a new bamboo plant may push its way out of the soil as far as 60 feet from where it started a few seasons before.

Fast growth isn't the only peculiarity of the bamboo tree. The term "tree" is a misnomer, because the bamboo isn't a tree, it's the largest grass in the world, closely related to oats, wheat, corn and sugar cane. Unlike its relatives, bamboo seldom or never produces seed. Records show that some bamboos flower only every 15, 30, 48, 60 or even 120 years! In many cases, all members of a species burst into bloom at the same time, only to die a short while later.

A forest vanishes

Auguste St. Hilaire, the naturalist, describes a fine forest of flowering, 50-foot-high bamboo that he passed one day in the Brazilian jungle. When he came that way again a few months later, the entire forest had vanished.

Because bamboo flowers so seldom, botanists aren't sure just how many different kinds there are. Estimates range from 200 to 700. Bamboo comes in many sizes from a dwarf less than a foot high that's small enough to be mowed, to a giant well over 100 feet tall with a trunk almost a foot in diameter. Most of the big bamboos, as well as the widest variety of plants, grow in the tropics of southern and southeastern Asia, but other warm areas have native species, too. A few species are reported from both Africa and Australia, and the island of Madagascar off Africa has more native species than the entire neighboring continent.

In the Western Hemisphere, native stands of bamboo grow from Chile to just south of Philadelphia. The United States has two native varieties which once formed the extensive "canebrakes" described by early explorers. Remnants of the canebrakes still exist in the South.

Bamboo is by no means confined to its place of origin. A good traveler, it's been successfully introduced in such unlikely places as New York City. During World War II, the Bronx Zoo received two young pandas as a gift from our then-ally, China. Native to a remote, mountainous province of China, pandas dine by choice on the tender young shoots of a certain kind of bamboo which grows wild in China. The zoo officials shipped in some bamboo from the South and offered it to the black and white infants, but the pandas disdained the somewhat withered shoots. At this point, one of the zoo officials discovered a fine stand of bamboo growing in the front yard of a resident of Queens, a borough of New York City. The resident gave permission for the shoots to be plucked each morning, and the pandas gobbled them up.

Panda fodder is only one of the innumerable uses to which bamboo

Bamboo looks like a tree, grows like a weed and makes everything from poles to pulp. It tastes good, too.

has been put for thousands of years, particularly in Asia. Asians eat bamboo shoots raw and cooked, powder the branches to make a drink, use big bamboos as timber and fashion innumerable articles from the medium-sized varieties. In Assam, a region of Burma, whole villages are built out of bamboo. Peasants in southern China construct houses, farm implements, bridges and rafts from bamboo. Bamboo pulp is the foundation of India's paper industry. The Japanese use the dried leaves to deodorize fish oils.

Bamboo is proving its worth in the modern world of science and technology, too. Back in the early years of the century, Thomas A. Edison used bamboo filaments in his first electric lights. Tabishir, a substance produced by tropical bamboos, has been found to make a fine catalyst for certain chemical reactions. Bamboo charcoal is demonstrably superior to other kinds of charcoal in electric batteries. Liquid diesel fuel has been distilled from bamboo branches and valuable enzymes extracted from shoots. Bamboo poles prop up television antennas and bamboo slivers serve as phonograph needles. Strips of bamboo reinforce concrete in China, while in Peru bamboo boards are used in large modern buildings. Light jackets of woven bamboo replace plaster of paris casts.

Bamboo has never been of much economic importance in the United States, although a certain amount has been imported each year for such items as fishing poles and handicrafts. A change in the bamboo picture may now be underway in this country, however. The U.S. Department of Agriculture, which grows over a hundred kinds of bamboo at its plant introduction station in Savannah, is actively encouraging the raising of bamboo as a money crop in the warmer parts of the U.S. Bamboo, according to the U.S.D.A., is useful for everything from poles to paper pulp, and it grows fast. It delivers a paying crop in six years, while it takes pine and other fast-growing native species 40 or 50 years to do the same job.

The U.S.D.A. suggests bamboo for such products as blotting paper and facial tissues, but a few Americans put bamboo to more exotic uses. A few years ago, Harry Partch, the classical composer, built a marimba out of 64 graded pieces of bamboo. Played with felted sticks, the instrument is called, appropriately, the "Boo." James Coghlan, who sells bamboo plants from his nursery at Saddle River, N.J., advises adding bamboo shoots to potato or tuna salad for a new taste treat. There's only one problem, he adds: if you don't cut the shoots quickly, they'll turn into logs.

PHYSICS

Physics and the pyramids

Is Egypt's Second Pyramid of Giza really solid stone, or do secret chambers exist? Man may at last find the answer—without damaging the pyramid—through new methods in physics.

by Jeanne Reinert

AN ALABASTER COFFIN, gold-plated thrones and sylvan fittings for slave-borne platforms, necklaces and bracelets of hammered gold and precious jewels, jars filled with food for an afterlife banquet, perhaps even a few remaining royal bones, swathed in dignity from 4,500 years ago—unusual results from a physics experiment. Yet these finds are the maximum possible from an experiment now under way in Egypt. The minimum find will also be hard news—that the Second Pyramid of Giza, also known as the Pyramid of Chephren, is a solid structure without unexplored chambers of any size.

The exploration is taking place without disrupting the pyramid in any way. That's a far cry from earlier attempts which called for forcing tunnels through the pyramids, as grave robbers sometimes did, to an 1837 attempt to blast

into chambers with gunpowder. This new technique is possible because of new methods in physics, available only in the past few years.

The present exploration uses cosmic rays, computers and spark chambers. It took a physicist, Dr. Luis Alvarez of Lawrence Radiation Laboratory, to concoct the method that will produce a three-dimensional look at the interior of the Second Pyramid, complete with chambers and a rough indication of their size. The project is a joint venture of the U. of California and Ein Shams U. in Cairo.

The three pyramids at Giza have fascinated travellers since they were built between 2,600 and 2,500 B.C. Majestic monuments towering over the desert sands, these three are the most impressive in Egypt. They were built by three early rulers. The most famous is the Great Pyramid of Cheops or Khufu. Chephren's is second in size. The third Giza pyramid is that of Mycerinus, the smallest and latest of the three.

For hundreds of years before the pyramids were built, Egyptian pharoahs had been preoccupied with providing themselves with elaborate burial chambers. Traditionally, these chambers were within the ground and furnished with numerous rooms that contained all the needs for the pharoahs' life after death.

Pyramids were a technological breakthrough for their time. Just as we are designing and building the first spaceships, the Egyptians were designing and building the first free standing structures in stone. At first, they used stone to imitate the old mud-brick structures. But mud-brick buildings

crumble and cannot be very large. Stone offered a whole new dimension and a flurry of pyramid construction followed the discovery.

The very first pyramid evidently began as a flat box of solid stone masonry about 200 feet square and 25 feet high. It topped a tomb shaft 90 feet below the ground surface. It then occured to an Egyptian architect to place a similar flat box, somewhat smaller on top of the first box. Soon five boxes of solid stone were built, stepwise, on top of one another. There was no thought of interior rooms.

Chambers of Great Pyramid

Later, pyramids were constructed the same way, but steps were filled with rubble to support a facing of limestone that sloped smoothly from top to bottom. Architects learned how to increase structural strength. They used larger stone blocks, and packing blocks were placed in slightly concave layers so courses tip up at the corners of the structure. Blocks were more accurately squared. These design improvements made it possible to build chambers within the pyramid itself. The Great Pyramid contains two chambers and two passageways to them within the pyramid, as well as an underground chamber.

To archaeologists and treasure-hunters alike, it seems odd that the Second Pyramid is solid. As Dr. Alvarez puts it, "Why would Chephren, after a boyhood spent watching his father's slaves erecting a beautiful and complex series of chambers and passages in the Great Pyramid, be content to erect a solid and uninteresting pile of limestone blocks as his own pyramid?"

The standard reply to a question of this type is that Chephren probably knew that his father's pyramid was robbed soon after the burial ceremony. Concluding that a pyramid could not be secured against grave-robbers, he abandoned any attempt to misguide would-be robbers. Instead he simply had himself buried in the central ground-floor chamber. The pyramid was just a monumental gravestone, erected to his memory.

The other possibility is that the upper chambers were so well hidden they have not yet been found. Or at least have been unknown for the past 3,000 years. No two pyramids have exactly the same floor plan. Dr. Alvarez points out that the subterranean chamber of the Great Pyramid was known to the Greek historian Herodotus in the fifth century B.C., but the upper two chambers were not discovered until the ninth century A.D. They were found by accident when a large slab fell from the passageway, shaken loose by tunnellers as they forced another passage. The sound of the falling slab led them to the original passage and thence to hidden chambers.

Is it possible that Chephren's architects were so wily they managed to hide the upper chambers until now? If so, Dr. Alvarez's experiment is designed to find them.

Cosmic rays, computers, spark chambers and 70 tons of equipment are being used in the pyramid search.

Although the art of putting rooms in the pyramid was known by Chephren's reign, it was a difficult feat. The pressure of the stone resting on the rooms was severe, requiring forethought and engineering skill to keep the roof of any chamber from collapsing.

The known burial chambers in the large pyramids are all small—18 feet high by 17 feet wide and from 18 to 46 feet long. The smaller the room is, the less difficult are the problems of weight. Dr. Alvarez's experiment depends on any hidden rooms being roughly the same size as the known chambers. If a room were unusually small, it might be missed by this experiment.

A formidable amount of gadgetry and equipment is needed to explore the pyramids via physics. Equipment alone weighs about 70 tons. All of it has been hauled into the underground burial chamber of the Second Pyramid.

The closest comparison between the pyramid study and another familiar process is that of X-ray photography. At the end of the pyramid study, the physicists will have an outline of the pyramid's internal structure. This picture, like an X-ray photograph, will be the result of sending high-speed radiation through a body that is not ordinarily translucent.

The pyramid study, however, will differ in many important ways from a doctor's X-ray. For one thing, the rays it will study are naturally occuring whereas X-rays are emitted from machinery built to focus them on a target. Because the pyramid study depends on rays that come from all directions, the angle of approach must be known.

The equipment inspects the pyramid by measuring the rate of decay of that part of cosmic radiation called muons. These tiny, subatomic particles bombard the earth from all sides. The speed with which muons travel has been analyzed and measured since they were discovered in the 1940s. In their travels through atmosphere and objects, muons strike other particles which cause them to split into smaller fragments or to deflect from their original path.

The muon's speed

Muons' speed and density depend on the substance they are travelling through. Thus, they speed through cotton candy and snow drifts, but plow more slowly through car doors, elephants and bar bells. In fact, the density of the material determines the muon's speed and quantity as it exits. The density of the material can therefore be gauged from the muon's path after it leaves a given material.

To measure the speed and angle of a muon's path requires a spark

chamber. The simplest spark chamber is made of two flat metal plates, spaced about two-fifths of an inch (one centimeter) apart. When a muon travels through the two plates, an electronic circuit suddenly applies a high voltage between the two plates. This causes a spark to jump between the plates, very nearly along the path of the muon. Anyone watching a spark chamber can see the spark with the unaided eye. In many spark chambers, the spark's path is recorded by two cameras so both the north-south and the east-west direction of the spark's jump can be noted. However, other methods of recording the muon's path have been developed without having to resort to photography and analysis of photographs. One of these puts two spark chambers a foot apart. Both are horizontal. Instead of sensing energy from the spark as light, the same energy is sensed as a flow of electric current. This signal can be recorded directly on magnetic tape for a computer.

The next problem the physicists faced, explains Dr. Alvarez, is "How nearly true is it that the muon we record in our spark chambers is still moving along the same straight line that defined its trajectory as it passed through the burial chamber?" As particles move through objects, they collide and have normally small changes in direction. Changes in direction can be calculated from the "Scattering Theory" which allows physicists to predict the number of muons whose direction is changed.

Muons travelling through rock have been measured and it is known that they travel a straight path until their energy is almost exhausted. At this point, the muon is more likely, on the average, to be deflected through larger and larger angles. Now the muons travelling through the pyramid, if it is solid rock, will have just enough energy to penetrate the burial chamber roof. If there is a hidden room in the pyramid, muons will have met less resistence and will be travelling in a straighter line than if they had gone through solid stone.

Counting the muons

The physicists need a way to detect the number of muons still travelling in a straight line after further journeys. They need another dense substance to slow the fast-moving muons still more. Thus, tons of iron bars have been brought in the burial chamber and placed just under the spark chambers. Under the five feet of iron bars are scintillation counters, able to count the number of muons striking them. If muons also are able to strike this layer, then their energy will be known. This information, plus the angle of travel from the spark chamber, will indicate whether or not there are hidden chambers.

The important information the physicists are looking for is a difference in the rate of muons coming in from one area. It doesn't matter that the initial counts were

Technically, everything is going for the physicists. It's merely a question of whether the chambers exist.

higher than the physicists anticipated. The picture they expect to create with the muon information depends on a difference in rate caused by muons travelling through a void, or room, in the pyramid.

Paths of muons have been recorded on magnetic tape daily for the past several months. It only takes one operator to check the equipment daily to be sure it is working and to put a new tape on the recorder. Tapes filled with data are sent to Ein Shams U. in Cairo for processing.

There was a delay of several months in the project because of last year's Middle East War. But the tapes are now ready for analysis by a computer in Cairo. There are several ways of doing this.

The matrix of numbers can be analyzed for small regions in which each sample is studied. Analysts would search for several neighboring regions which have statistically significant differences from the pyramid as a whole. If such a region showed up, the numbers could be converted into a picture comparable to an X-ray photograph. The numbers would be projected as lines on a cathode ray oscilloscope, a common practice, and this could be photographed by a camera. It is then possible to locate the region of a hidden chamber, if there is one.

Dr. Alvarez states, "There are no technical reasons why the proposed experiment would not detect the chambers it is designed to find." The cosmic rays now known and the equipment available are exactly suited to exploring pyramids. If muons moved 10 times slower, the experiment would be impossible. If they moved 10 times faster, it would be impossible.

If the pyramids were 20 feet higher, the muons could not penetrate as far as the underground chamber. If there were no underground chamber and one had to be blasted out in order to put the spark chambers inside the pyramid, the experiment would not be practical financially. As it is, the study will cost about ■ half-million dollars.

What happens next

If the experiment reveals chambers, the apparatus will be moved to the other two Giza pyramids to check their internal floor plans. But the underground chambers in both are filled with rubble and all of it would have to be removed, a time-consuming task.

The joint pyramid project is an exciting one. It will be even more exciting if the physicists do reveal a network of chambers or even a single unplundered chamber that would give the 20th century a look at an ancient pharoah's funerary pomp and pageantry.

U.P.I.

PIX

The world's worst weather

From the parched sands of the Sahara (above left) to the Greenland ice cap (below left) here are all the awful things that can happen.

by Bruce Frisch

ABOUT THIS TIME every summer I begin to hate hot weather. Sometimes it gets so bad I start wishing it were winter again. Which only goes to show that as far as weather is concerned, I'm never satisfied.

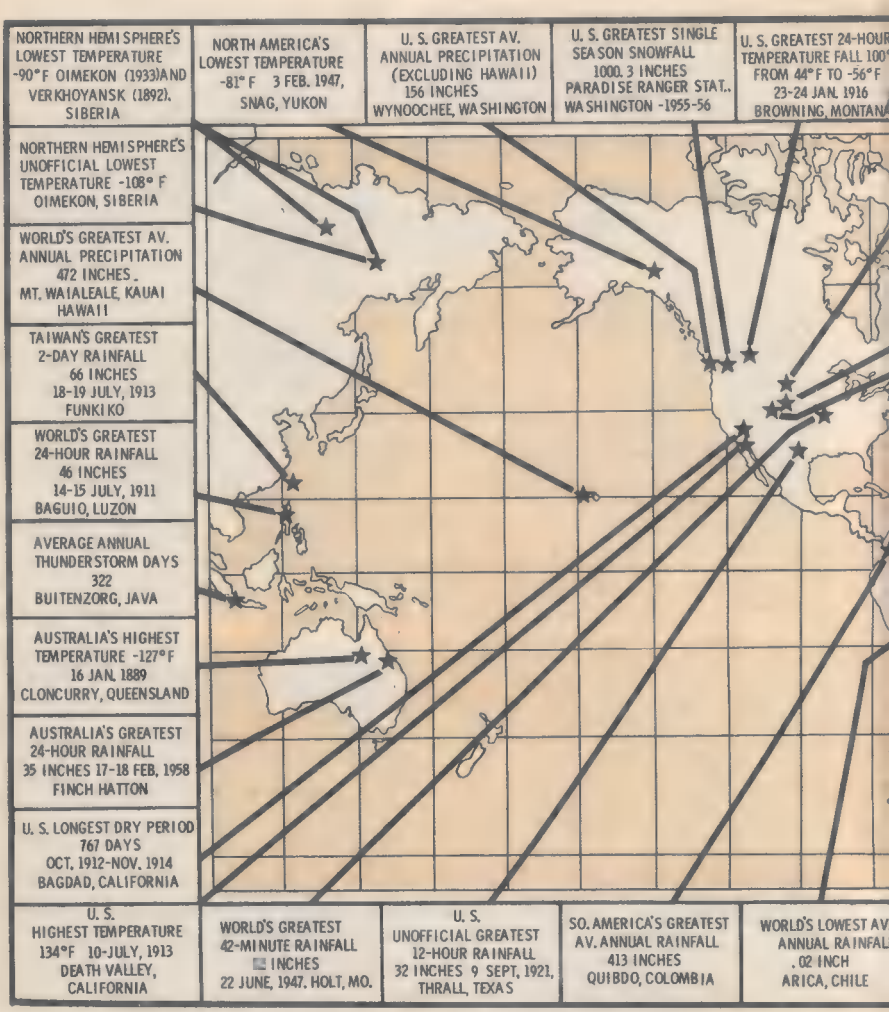
I can recall an icy day last January. I was shivering my way through midtown Manhattan glaring at a huge electric sign, advertising an airline. "The temperature in Miami is now 78°," the sign said.

Since I had no prospects of getting farther south than the 42nd Street library, I angrily started digging through weather books. As I browsed, it became clear that no matter how rotten the day is where you are, the weather is worse somewhere else.

Florida's weakness is hurricanes. After all, who wants to spend a lot of money getting somewhere where he may be sandblasted to death? This actually happened to several people during the Labor Day hurricane of 1935. All their clothes—except belts and shoes—and their skins were rubbed off. Accompanying the bizarre execution was a beautiful spectacle. The air appeared filled with fireflies as electrostatic charges on the sand sparked from one wind-whipped particle to another. This was the most violent Atlantic hurricane of the century. Winds were estimated at over 200 miles per hour.

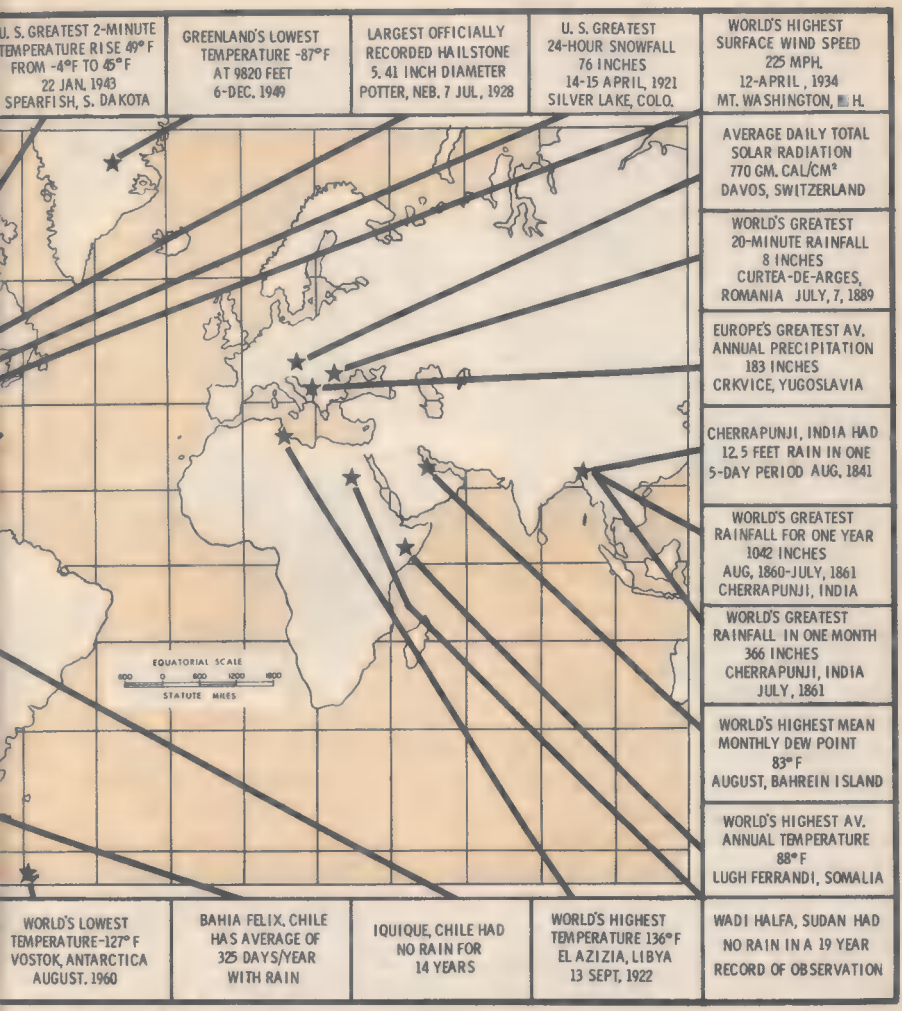
When Florida was still a swamp, hurricanes were flattening colonies in the Antilles. In 1790, a hurricane struck Tobago, lifted a mansion just built by a Mr. Hamilton, and set it down some distance away. Mrs. Hamilton, two other ladies and five children inside were unharmed. Mr. Hamilton was away for the day and knew nothing of what had happened. Returning that night, he groped in the dark for his door, fell over some debris and was laid up for a week.

Aside from tornadoes, the highest wind ever recorded was on top of Mount Washington in New Hampshire's White Mountains. For years the Weather Bureau could not tell just how windy Mount Washington was, because all their anemometers blew away or froze solid. Finally, in 1932, a specially rugged, electrically heated instrument was placed at the peak. Two years later, on April 12, 1934, the winds mounted, and shortly after noon blew an average of 188 miles per hour for five minutes. At 1:21,


NORTHERN HEMISPHERE'S LOWEST TEMPERATURE -90° F OIMEKON (1933)AND VERKHOYANSK (1892). SIBERIA
NORTH AMERICA'S LOWEST TEMPERATURE -81° F 3 FEB. 1947, SNAG, YUKON
U. S. GREATEST AV. ANNUAL PRECIPITATION (EXCLUDING HAWAII) 156 INCHES WYNOOCHEE, WASHINGTON
U. S. GREATEST SINGLE SEASON SNOWFALL 1000.3 INCHES PARADISE RANGER STAT., WASHINGTON -1955-56
U. S. GREATEST 24-HOUR TEMPERATURE FALL 100° FROM 44° F TO -56° F 23-24 JAN. 1916 BROWNING, MONTANA
NORTHERN HEMISPHERE'S UNOFFICIAL LOWEST TEMPERATURE -108° F OIMEKON, SIBERIA
WORLD'S GREATEST AV. ANNUAL PRECIPITATION 472 INCHES MT. WAIALEALE, KAUAI HAWAII
TAIWAN'S GREATEST 2-DAY RAINFALL 66 INCHES 18-19 JULY, 1913 FUNKIKO
WORLD'S GREATEST 24-HOUR RAINFALL 46 INCHES 14-15 JULY, 1911 BAGUIO, LUZON
AVERAGE ANNUAL THUNDERSTORM DAYS 322 BUITENZORG, JAVA
AUSTRALIA'S HIGHEST TEMPERATURE -127° F 16 JAN. 1889 CLONCURRY, QUEENSLAND
AUSTRALIA'S GREATEST 24-HOUR RAINFALL 35 INCHES 17-18 FEB. 1958 FINCH HATTON
U. S. LONGEST DRY PERIOD 767 DAYS OCT. 1912-NOV. 1914 BAGDAD, CALIFORNIA
U. S. HIGHEST TEMPERATURE 134° F 10-JULY, 1913 DEATH VALLEY, CALIFORNIA
WORLD'S GREATEST 42-MINUTE RAINFALL INCHES 22 JUNE, 1947. HOLT, MO.
U. S. UNOFFICIAL GREATEST 12-HOUR RAINFALL 32 INCHES 9 SEPT, 1921, THRALL, TEXAS
SO. AMERICA'S GREATEST AV. ANNUAL RAINFALL 413 INCHES QUIBDO, COLOMBIA
WORLD'S LOWEST AV ANNUAL RAINFAL .02 INCH ARICA, CHILE

the peak gust buffeted the observation building at 231 miles per hour. All that held the structure together, said Salvatore Pugliuca, the chief observer, was the thick coating of frost.

In the chill dampness of the library I began to feel warm. I felt positively toasty when I discovered that in Verkhoyansk, in east-central Siberia, January temperatures would average 58° below zero. There, where the cold air collects in the valley of the River Yana, the highest January temperature ever recorded was two


U. S. GREATEST 2-MINUTE TEMPERATURE RISE 49° F FROM -4°F TO 45°F 22 JAN. 1943 SPEARFISH, S. DAKOTA
GREENLAND'S LOWEST TEMPERATURE -87°F AT 9820 FEET 6-DEC. 1949
LARGEST OFFICIALLY RECORDED HAILSTONE 5.41 INCH DIAMETER POTTER, NEB. 7 JUL., 1928
U. S. GREATEST 24-HOUR SNOWFALL 76 INCHES 14-15 APRIL, 1921 SILVER LAKE, COLO.
WORLD'S HIGHEST SURFACE WIND SPEED 225 MPH. 12-APRIL, 1934 MT. WASHINGTON, N. H.
AVERAGE DAILY TOTAL SOLAR RADIATION 770 GM. CAL/CM² DAVOS, SWITZERLAND
WORLD'S GREATEST 20-MINUTE RAINFALL 8 INCHES CURTEA-DE-ARGES, ROMANIA JULY, 7, 1889
EUROPE'S GREATEST AV. ANNUAL PRECIPITATION 183 INCHES CRKVICE, YUGOSLAVIA
CHERRAPUNJI, INDIA HAD 12.5 FEET RAIN IN ONE 5-DAY PERIOD AUG. 1841
WORLD'S GREATEST RAINFALL FOR ONE YEAR 1042 INCHES AUG, 1860-JULY, 1861 CHERRAPUNJI, INDIA
WORLD'S GREATEST RAINFALL IN ONE MONTH 366 INCHES CHERRAPUNJI, INDIA JULY, 1861
WORLD'S HIGHEST MEAN MONTHLY DEW POINT 83° F AUGUST, BAHREIN ISLAND
WORLD'S HIGHEST AV. ANNUAL TEMPERATURE 88° F LUGH FERRANDI, SOMALIA
EQUATORIAL SCALE
STATUTE MILES
WORLD'S LOWEST TEMPERATURE -127° F VOSTOK, ANTARCTICA AUGUST, 1960
BAHIA FELIX, CHILE HAS AVERAGE OF 325 DAYS/YEAR WITH RAIN
IQUIQUE, CHILE HAD NO RAIN FOR 14 YEARS
WORLD'S HIGHEST TEMPERATURE 136° F EL AZIZIA, LIBYA 13 SEPT, 1922
WADI HALFA, SUDAN HAD NO RAIN IN A 19 YEAR RECORD OF OBSERVATION

above. As one goes north from this Asian cold pole it gets warmer, until at the shore of the Arctic Ocean the January average is 25 degrees higher.

During the summer, Verkhoyansk is about as warm as Bogota, Colombia, or Eureka, in northern California, with a July average of 56°. This gives Verkhoyansk the world's largest temperature range, 114 degrees. From October to November the average drops 40 degrees. The span from its record low of 94° below to its record high of 98° above is a tremendous 192 degrees.

North Dakotans, who have the widest annual temperature swings in the United States, can take comfort.

For daily changeability, however, it is hard to beat the United States. Nowhere else in the world has the steady march of cyclones, or lows, from the Rockies, across the midwest and then northeast out over the North Atlantic. All the storm tracks converge at the St. Lawrence River Valley, giving northern Vermont the most variable daily temperatures in North America. As the storm fronts pass, polar air alternates with tropic breezes.

Falling temperatures

Over the plains, cold fronts strike faster and harder, if not as often. In Houston, Texas, where such fronts are called "northers," the temperature has dropped from 75° at midnight to 22° at nine the next morning.

In this pattern of rapid change, cloudy skies are always followed by sunshine. But imagine being in swinging London during December when there is an average of only 15 minutes of sun a day. Gloom can show up in peculiar places. Along the 1,500-mile-long coastal desert of Peru and Chile, a cold current hugging the shore forms an almost constant deck of stratus clouds. During August and September the clouds may not part for weeks on end. The seaward extension of the cloud layer is so narrow, however, that the sun may suddenly pop into sight at sunset.

This desert is a good place to think of now when your grass is turning brown. Rain falls only every few years. It comes not from the clouds overhead that always threaten but never rain, but from summer showers, when moist air from the Atlantic spills over the Andes to the east.

To the north on the coast, desert quickly changes to one of the rainiest regions of the world in Colombia. There at Quibdo, equatorial winds spill over 34 feet of rain a year a few hundred feet up the Andean slope. About every dozen years a particularly fierce spell of winter in the northern hemisphere pushes the equatorial winds and currents south to the desert. Floods destroy towns and irrigated farms. At the same time, the warm, less salty, invading current kills the rich sea life that supports a thriving fishing industry.

All the world's highest annual rainfalls occur where constant moist onshore winds are rung out by hills or mountains. Rainfall records for a few days down to an hour or so are set mostly by hurricanes and typhoons.

Unofficially, at least, those for a few minutes are produced by cloudbursts in thunderstorms. Intense updrafts carry falling rain back up into the cloud. When the updraft stops, all the rain comes down at once. On July 3, 1892, a cloudburst hit a hillside above the village of Langtoft, Yorkshire, in England, scouring the fields down to

Port Sudan is the hottest soggiest place in the world, except perhaps a midsummer traffic jam in the U.S.

bare rock, sweeping away two cottages and flooding the streets with seven and a half feet of water. It was estimated that 100 inches had fallen on the small patch of ground.

Most of us don't worry about summer hail. But to the farmers of Nebraska, Kansas and Iowa, it is a menace. Baseball-size hailstones can flatten a field of crops, and in a few minutes wipe out a year's work. In May, 1930, a 39-year-old farmer near Lubbock, Texas, was caught in a hailstorm and pelted to death. Yet American farmers can be thankful they do not get hailstorms like those in India.

At Moradabad, 100 miles east of Delhi, a hailstorm on April 30, 1888, killed 230. Most died when they were struck down by hailstones and wind and buried under drifts of the kind that often freeze into solid blocks.

Hailstones grow when updrafts estimated at over 200 miles per hour prolong their stay in the super-cooled regions of a thundercloud. Winds like these caught five German glider pilots who had soared into a thundercloud over the Rhön Mountains, then bailed out when they became afraid their craft would be torn apart. All landed encased in ice, and four of them were frozen to death.

To feel cooler during a New York heat wave, concentrate on the inhabitants of the Sahara, where, at In Sallah, there was once a 45-day stretch in which the average daily high was 118 and there was no temperature below 70°. The world's highest temperature, 136, was recorded at El Azizia, Libya, near the Mediterranean. Yet near here, in 1949, 95 persons died when they were trapped in 12-foot snowdrifts.

The air in the Sahara is so dry that even when it rains, the water often evaporates completely before it hits the ground. Wood warps and leather hardens and splits, but the very dryness enables man to survive by drinking and sweating five quarts of water a day. It is where the air is humid as well as hot that a man really suffers from the heat.

Peculiarly, the worst places are not in the equatorial jungles. For sheer swelter the shores of the Persian Gulf and the Red Sea are unsurpassed. Usually a body of water moderates nearby land temperatures. During the summer the waters of the Persian Gulf reach 96 and the Red Sea, 94. Consequently, at Port Sudan on the Red Sea, July temperatures fluctuate each day on the average between a high of 106 and a low of 83. Combined with this is the soggiest air in the world. The only thing that can sustain a parboiled Port Sudanese in the summer is the thought of Americans stranded in steel ovens during rush-hour traffic jams.

1. **The world's largest** and fastest commercial cargo vessel, the **S.S. Ponce de Leon,** traveled at 25 knots on her maiden voyage. The 700-foot long ship is operated by the Transamerican Trailer Transport, 358 St. Marks Place, Staten Island, N.Y.

2. **10-inch diameter flywheel** (shown beside larger aircraft tire) was tested by North American Rockwell Corp., Los Angeles, lifting simulated B-70 landing gear (2,300 pounds) for Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio.

4. **This mirror disc** of fused silica (100 inches in diameter), made by Corning Glass Works, Corning, N.Y., is accurate to one-millionth of an inch. It is being used in the world's largest optical collimator for testing precision photographic lenses.

5. **Turning night into day** is the purpose of Night Window, developed by Kollsman Instrument Corp., Syosset, N.Y. Light-sensitive television and advanced optics gives this pilot a daylight view on foot-square screen behind his windshield.

3. **Instant mobile teletype** terminals are possible by attaching a TC-3 cart that goes anywhere, providing data communication with only ordinary telephone and power outlet. Anderson Jacobson, Inc., 2235 Mora Dr., Mountain View, Calif.

6. **A compact laser system** weighing less than 10 pounds is available from American Optical Co., Space-Defense Division, Southbridge, Mass. The Uni-Laser, with operating life of 100,000 firings, also comes with a 50-joule power supply.

Photos by Bruce Frisch

Violins of the future

by Bruce Frisch

SOFT SOUNDS of a violin floated from the instrument before me, but not a hand was touching it. "Do you hear?", a woman called from the next room. Mrs. Carleen Maley Hutchins was playing the violin electronically, displaying how the secrets of the great violin-makers of three hundred years ago had been uncovered. With scientific techniques, Mrs. Hutchins says she can now make violins the equal of all but their very best.

"There is one group of very excellent instruments, something out of this world. There are 20 or 25 of them, and they're in the $50,000 bracket," Mrs. Hutchins said earlier

Mrs. Carleen Maley Hutchins suspends violin with rubber bands. Magnetically linked to a loudspeaker coil which vibrates the instrument, Mrs. Hutchins can "play" it from an adjoining room. It is one method she has of testing a violin in the making.

as we sat in the living room of her home in Montclair, N. J.

"Then there are several hundred second line violins at around $20,000." She claims to be able to match these. "There are enough second line instruments to fill the United States orchestras," she continued.

Where does that leave the Europeans?

"Instruments are moving into this country, because the money is here. Musicians are mortgaging their futures to buy them. It's criminal," she said indignantly.

Collectors are harming some top instruments by taking them out of use. A violin has to be played regularly to sound good. Others are taken out of circulation when they are given to museums for tax write-offs, as is done more often with paintings. "It's an antiques game now," said Mrs. Hutchins.

Many of these coveted violins are the handiwork of Andrea Amati, who may have invented the violin in Cremona, Italy, around 1580, and his successors, Guiseppe Guarneri, and Antonio Stradivari, who worked into the early 1700s.

Time has improved on their artistry by doing something to the wood that makes old violins sound better. "No concert violinist would choose a modern instrument," said Mrs. Hutchins. Eventually these 300-year-old fiddles will go downhill. It's not generally known, confided Mrs. Hutchins, but two of the most famous violins are now "shot."

The difference in tone and power between the $50,000 violins and the $20,000 second line can be detected by only about 20 to 25 persons in this country, and cannot be captured on tape.

During the 1930s, Dr. Frederick A. Saunders, then chairman of the department of physics at Harvard University, set out to define the difference. "He thought it would be easy to do, but it still hasn't been cracked," said Mrs. Hutchins.

He first consulted the experts, but got little help. Among performers, "some really intelligent people said that their violins would be improved by allowing them to listen to a Heifetz concert," recounted Dr. Saunders.

And violin-makers, says Mrs. Hutchins, "have formed a cult that has been plagued with more peculiar notions and pseudo science than even medicine."

One of the notions, Dr. Saunders learned, was of "a magical varnish which was supposed to do wonders for any violin, but its secret was lost." The mystery of the magical varnish may have been uncovered recently by Dr. John C. Schelleng, former director of radio research at the Bell Telephone Laboratories, and an associate of Mrs. Hutchins.

Varnish can do only harm, Dr.

Mrs. Hutchins started by building her own viola. It was pronounced "the work of a good carpenter". Well beyond that stage now, she builds all the conventional stringed instruments, from violins to bass, in her basement workshop. She believes that craftsmanship, plus scientific knowledge, will allow her to duplicate all but

the very best of the violins. But years of effort taught her there was no way to improve on the basic design worked out by the Cremona masters nearly 400 years ago.

Schelleng found. "Could it be that the secret is the technique of using the least possible amount of varnish?", he wonders.

After sifting out all the nonsense, the key qualities Dr. Saunders felt he had to explain were pleasing tone and great loudness, uniform all the way from the low notes to the highs.

For years he tested violins valued at $5 to $50,000, including Jascha Heifitz' Strad and Guarnerius. His electronic analyses pointed to the frequencies of three loudness peaks as the key factors. One peak was caused by the resonance of the wooden body. In good violins it fell at the tone of the unfingered second highest string. The second peak was the resonance of the air inside the violin. In Heifitz' Guarnerius it coincided with the unfingered third string. The note one

Building a violin takes Mrs. Hutchins 100 hours, but the work is spread out over several years. The woodworking is extremely delicate, involving the use of tiny planes like those pictured above. More important even than the woodworking is the constant testing. Her cat often sleeps among the electronic equipment (above right), but casual atmosphere is deceptive. By the time one of her violins is finally assembled, it should provide no surprises. Preferring to work at home gives Mrs. Hutchins freedom, but it also tends to give the impression that she is a part-time dabbler —an impression she does not merit and strongly resents.

octave below the wood resonance falls just above the lowest note on the violin. The wood resonance is the first overtone for this note and strengthens the sound heard considerably, creating a third peak to boost the low end. Evenly spaced this way the three peaks give the instrument a relatively even loudness over its whole range.

During the years of this research, Mrs. Hutchins was graduating from Cornell University, becoming a science teacher at the Brearley School in New York City, marrying a chemist and taking up the viola. When she could not afford a better viola, she made one. It was pronounced "the work of a good carpenter," but it gave her enough confidence to volunteer to make test instruments for Dr. Saunders. She had read of his studies and noticed that he could not make any changes in the instruments he tested, because they were borrowed and made according to convention.

In collaboration they spent 1950 to 1958 varying such things as wood thickness, size of f-holes and rib height. They learned two things, how to shift and strengthen the two key resonances to make a good violin at will, and how impossible it was to improve on the design perfected by the Cremona masters.

"Let me show you how I work," said Mrs. Hutchins, and she led me down to the cellar. She had hung one small room with a double row of heavy drapes and tossed old tires on the floor to make it free of echoes. From a pipe frame she

suspended a violin with rubber bands and magnetically linked its bridge to a loudspeaker coil which would vibrate the violin like a paper speaker cone. A microphone was positioned to pick up the sounds the violins made. She latched the door and sat down in front of a bank of electronics equipment in the next room. Her Siamese cat slept on the warm top. She fed power to the speaker in a range of frequencies from below the threshold of hearing to above its limit. It was then I heard the violin come alive. The microphone picked up the response, and a recorder plotted a graph of loudness against frequency. In a third room were woodworking tools for roughing out pieces. The secret of this violin maker is that she can handle almost everything herself.

In making a violin, a look at the curve tells her whether the three important resonances are properly placed. If the air resonance is too low in frequency, she may raise it by enlarging the f-holes or reducing the air space by shortening the ribs.

The wood resonance of the assembled violin depends largely on the separate resonances of the top and bottom plates. The stiffer they are, the higher their resonances. A smaller, thicker, plate with higher arching would tend to have a higher resonance. Mrs. Hutchins has determined what the top and bottom resonances should be to give the required resonance in the assembled instrument, and has found that the peak loudnesses of the two plates should alternate for best tone. While making the plates, she carves, tests, carves and retests again and again to get the right relationships. By the time she tests the assembled instrument, there should be few surprises.

During her training as an artisan she worked with the famed Simone Sacconi at the Wurlitzer shop in New York. Sacconi guided her in making a viola as closely as possible to the exact way Stradivari had done it. "He even had me twisting rope instead of using clamps. I gave that up," chuckled Mrs. Hutchins.

It starts with the trees

Her fund of knowledge begins with the trees in the forest. A person in Vermont offered to cut wood on his land for her. "I went walking through the woods with two foresters. You reach up with an axe and clunk the tree. If it has grown twisted and there are a lot of tensions in it, it rings differently," explained Mrs. Hutchins. She looks and listens for a tree that has grown straight and true.

Out in her garage she showed me what looked like a pile of cordwood for the fireplace. It was from the estate of a violin maker. She also gets wood from Czechoslovakia that was cut 75 years ago, and salvages more old wood from barns. Her most ancient wood dates back to 1800.

It goes against Mrs. Hutchins' grain to have to depend on craft

Romantics may like hand craftsmanship, but Mrs. Hutchins hopes to see violin production automated.

lore in selecting wood. On her frequent visits to universities to lecture, she tries to interest scientists in finding out what in the microstructure makes one wood better than another, in devising an accelerated curing process or even making a suitable uniform synthetic material.

Actual construction of the instrument takes her about 100 hours, but this is spread over two to three years. She carves a little, then lets the piece sit to relieve internal stresses.

The greatest test of her abilities began in 1960 when she and Dr. Saunders started developing a completely new family of fiddles. The other three conventional strings, viola, cello and bass, are inferior to the violin, and all four instruments come nowhere near spanning the range of the piano keyboard. Dr. Saunders and Mrs. Hutchins decided to make eight instruments, essentially blown up and miniaturized versions of the perfect violin.

When possible, Mrs Hutchins altered existing odd-sized instruments. The largest, the contra bass, seven feet tall overall, and the smallest, the treble, with a body 10½ inches long, she had to make entirely herself. The contra bass would have been larger and the treble smaller if she had simply followed violin scale, but they would have been unplayable. To make them manageable sizes Mrs. Hutchins varied wood thickness, arching, rib height and size of f-holes.

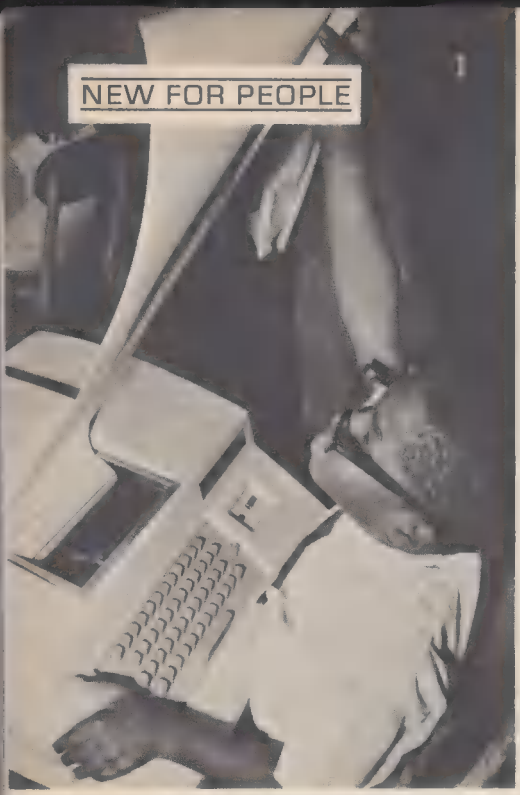
After playing with the new more powerful instruments, violinists complained they could no longer be heard. They had already been having trouble reaching the backs of recently built, larger halls when playing solo. So Mrs. Hutchins made a slightly enlarged violin. Like a larger loudspeaker, it could set more air in motion. But without her scientific knowledge, she could not have made it sound like a violin.

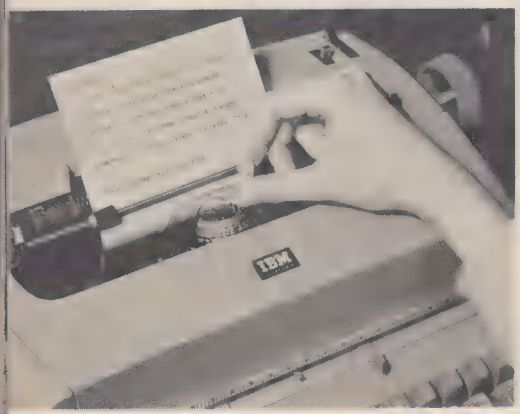
Automated production

Eventually Mrs. Hutchins, Dr. Schelleng and the others who work with her, hope to know the violin so well they can put instructions on computer tape to run an automated production line. Then every student could have for perhaps $1,000 an instrument as good as the ones now costing $20,000.

Progress might be faster if she were on a university faculty, but Mrs. Hutchins has preferred to stay on her own. Working at home can make the scientist-artisan misunderstood. Sometimes she *did* work here in the kitchen, she said. "But please," she pleaded, "Don't say, 'Housewife makes fiddles in her kitchen.' I've had enough of that."

NEW FOR PEOPLE





1. A student in a Brooklyn public school looks at a sheet of figures produced by his desk computer. The RCA computers were put into use in the school this year. Students can do drills and practices tailored to their individual needs in key subjects. 2. An experimental electronic telephone has been developed by Bell Telephone Laboratories, Murray Hill, N.J., with design consultation by Henry Dreyfuss and Associates. Further tests and development are expected to bring about extensive changes in the phone. 3. A stainless steel tape which spirals into a three-foot self-supporting tube has been developed by Avco Electronics Division, Cincinnati, Ohio. It has been proposed for combat pack radio antennas, because it can be retracted on a spool when not in use.

Keystone

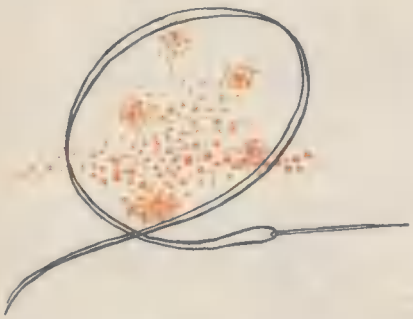
4. Over 500 technical, foreign and numerical symbols can now be typed on any IBM Selectric typewriter with an attachment called Typit II. Mechanical Enterprises, 3127 Colvin St., Alexandria, Va., has produced the device, which is easily and inexpensively installed. 5. This inflatable pneumatic jack of neoprene-nylon is placed under an auto and a rubber pipe is connected to the vehicle's exhaust pipe, which inflates the bag when the engine starts. By Research and Development technicians, Cardington, Beds, England. 6. A low-cost laser for the school market was tested atop the Wells Fargo Building in San Francisco, and its light—one-half milliwatt in power—was the brightest thing in the sky. By Electro Optics Associates, 974 Commercial St., Palo Alto, Calif.

MEDICINE

Stitches that kill bacteria can save lives

by Arthur J. Snider

SUTURES impregnated with a bacteria killer have prevented infection following surgery in test animals. If results can be repeated in human patients, says Dr. Harry H. LeVeen of the Brooklyn Veterans Administration Hospital, it would mean realization of a goal that has been sought since the first days of antisepsis almost a century ago. Despite all advances since then, post-operative infection has



remained a problem. Studies have shown that as many as 6 percent of all "clean" operations turn out to have some infection at the site of the wound. For conditions in which infection is more probable, such as peritonitis, the infection rate can be doubled.

"Lord Joseph Lister, who originated the concept of antisepsis, attempted to prevent post-surgical infection by impregnating sutures with carbolic acid. However, the acid was too irritating to the tissues," Dr. LeVeen explains.

"Now the effort has been revived. The major problem has been to find an antibacterial substance that is effective against a wide range of infectious bacteria and released slowly enough from the sutures to provide protection for the first critical days after surgery."

Antibiotics were an obvious choice, but no single antibiotic is useful against a full range of bacteria. Additionally, no method has been found to release the drug slowly enough.

Dr. LeVeen has used a bacteriocidal formula called benzethonium chloride, widely used to wash patients' skin before surgery. To insure slow release, it was mixed with oleic acid. The compound breaks down slowly, releasing the bacteria killer over a period of several days. In addition, it is effective against a wide range of bacteria.

Tests were conducted on mice injected with varying numbers of staphylococci. When 390,000 germs were injected, 103 of 150 mice with no sutures developed infections, while 150 with ordinary sutures were infected. Of 150 mice receiving impregnated sutures, no infection developed.

More animal tests will be required

over the next several years to make sure the sutures live up to their early promise before they can be made available for human patients.

Student suicides mount

Parental pressure to make good grades is helping drive the suicide rate among college students to an all-time high. In 1966, suicide threats were made by more than 100,000 college students. One in 10 of these actually attempted suicide, and 1,000 succeeded. Suicide among students is now the second greatest cause of death in the 15-24 age range.

In citing these statistics, Dr. Mathew Ross of Harvard Medical School says one of the solutions is for parents to ease expectations and demands for excellence in performances.

The typical suicidal college student is one who is away from home, lonely, working hard, anxious to do well. When he is not doing well, he may seek to repress his anxiety with liquor, sex or accepted forms of student violence.

"When these are exhausted and the student remains alone, he has three alternatives," says Dr. Ross. "He can cope and muddle through, see a physician, or as many do, commit suicide."

Dr. Ross believes that suicide is predictable and preventable by recognizing tip-offs. A student may show sudden behavior change, particularly withdrawal. He seldom leaves his unkempt room, even for meals. He may develop a disheveled appearance, a worried, harried, furrowed brow. He has difficulty concentrating. The printed page has no meaning. He broods and daydreams. He may sit all day listening to hi-fi music.

Artificial valves do the job

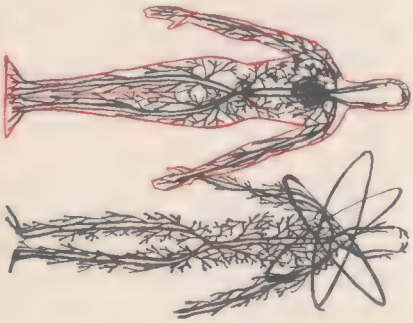
Surgical replacement of diseased valves with artificial ones has become so perfected that the mortality rate is only one in 20. Of the 50,000 persons who have had such surgery since the first trial in 1961, about 75 percent are still alive, according to Dr. Albert Starr of Portland, Ore., and Dr. Arthur C. Beall Jr., of Houston, Texas. Slightly more than half the deaths can be related to the use of prosthetic valves. Two-thirds of remaining deaths result from blood clots, another problem.

Blood treated outside body

Massive doses of high level radiation can destroy leukemia cells in the human body, but they also harm the patient. After four years of experimenting on animals, a partial answer has been found at the Brookhaven National Laboratory. The procedure is to irradiate the pa-

tient's blood outside the body and return it to him after treatment.

The blood is taken out of the body through a tube connected to the artery at one end and to a vein at the other. Most of the tubing is enclosed in a gamma radiation de-



vice near the patient's bedside. As the blood flows through the irradiator, the radiation-sensitive leukemia white cells are destroyed, while the more resistant red cells are not affected.

The new procedure, called ECIB (Extra-Corporeal Irradiation of the Blood), is not a cure but a controlled treatment, Brookhaven scientists stress. They have found ECIB has lengthened the lives of some of the patients on whom it has been tried.

Hodgkin's prognosis

The outlook for Hodgkin's disease, a chronic malignancy of the lymph glands, has become brighter. Survival time has improved steadily. When the disease is limited to one area of the body, 40 percent of patients survive beyond 10 to 15 years.

Effectiveness of very high voltage radiotherapy is responsible to a large degree for the new optimism in the curability of Hodgkin's disease, according to "The Medical Letter," a publication which evaluates therapy and drugs for 35,000 physicians and others in the health professions. The present trend is to apply high doses of X rays in areas adjacent to the affected regions of the body as well as to the known ones, because the disease advances by direct extension.

If several areas of the body are affected, drugs alone, or in association with localized X ray therapy, have succeeded in 60 to 80 percent of patients in achieving temporary suspension of the disease.

Spray better than flu shot

Dead flu virus sprayed directly into the respiratory tract has been found superior to standard flu shots in protecting against influenza, a study on over 2,000 Florida prisoners has shown.

Dr. Robert H. Waldman of the University of Florida department of microbiology, says the technique provides greatest protection during an influenza epidemic and a lowered incidence of vaccine side-effects, including freedom from a sore arm, a common aftereffect.

When an Asian flu epidemic

hit the Florida State Prison in January, the spray was 79 percent effective. Flu shots were only 23 percent effective. Only eight volunteers of the 330 men (2.5 percent) receiving the spray vaccine became ill with flu. Of the 260 given standard flu shots, 9 percent got the flu. In a third group of 1,400 prisoners receiving no protection at all, the illness rate was 12 percent.

Thymus transplant works

The first transplant of a thymus gland was performed on a seven-months-old baby boy. Dr. William W. Cleveland, pediatrician at the University of Miami medical school, said a subsequent transplant of a piece of skin to the infant was rejected, indicating that the thymus transplant had successfully taken. The thymus is believed to be involved with graft rejection and the immunological reaction. The infant is now almost two years old and doing well. All available indications show he has a normal thymic function.

'Perfect' child has problems

Parents whose tiny toddlers act like angels should beware. It's far more natural for tots to get into everything. This is a normal, healthy attempt to reach out and discover their world around them, says the Illinois State Medical Society.

"Angelic" children who meekly obey orders to sit still and never reach out for the world around them usually have some physical or psychological defect. Their timidity is an abnormal attempt even at this early age to gain approval and acceptance from their elders. Studies also show these children suffer far more physical disorders than their less well-behaved counterparts, especially upper respiratory tract infections.

Metal knee joints

Young housewives are walking about on implanted knee joints made of metal after their own bony joints were removed because of severe arthritis. The only alternative to the prosthesis was a permanent stiffening of the knee, according to Dr. Frank C. Wilson Jr., of Chapel Hill, N.C.

Still unknown is how long the hinge-type joint will last, since friction could gradually wear away the Vitallium metal. Patients have gone as long as 10 years with a similar

artificial joint in Sweden, Dr. Wilson reported to the American Academy of Orthopedic Surgeons.

"This is not a perfect prosthesis," Dr. Wilson says. "The motion of walking is not completely normal. But it has relieved pain and enabled them to get about without crutches."

A prenatal checkup

Doctors now can peer into the amniotic sac, home of the unborn baby, and determine the state of its health. By injecting into the fetus material that is non-transparent and thus visible to X ray, the physicians can determine whether the fetus is free of difficulties and deformities.

The diagnostic technique, known as amniography, also can determine whether the umbilical cord is in position not to interfere with normal birth and whether the infant is an Rh blood problem.

Dr. John T. Queenan, assistant clinical professor in the New York Hospital-Cornell Medical Center, says amniography goes beyond the standard procedure of withdrawing and analyzing amniotic fluid, the shock-absorbing material in which the fetus floats.

A fluid analysis may reveal that the fetus is involved in some kind of trouble, but it cannot determine the extent of the trouble. The X ray procedure, on the other hand, can define the nature of the trouble and specify the best time for an early delivery, should one be necessary.

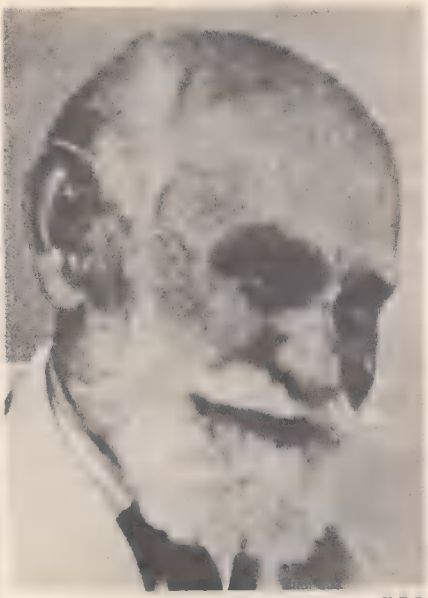
The technique requires removing an amount of amniotic fluid and replacing it with an equal volume of non-transparent material. About 150 to 225 drops are usually enough for a fetus 22 to 28 weeks old. When injected through the uterus and into the amniotic sac, the opaque material disperses uniformly through the fluid, outlining the baby. The fetus also swallows some of the material so that its gastrointestinal tract also is outlined. Eventually the material is excreted by way of the maternal blood stream.

New drug for Parkinson's

A major drug advance against Parkinsonism, the "shaking palsy" disease, is foreseen by neurologists. A drug, L-Dopa, has brought about some "very dramatic" reversals of tremors in some patients. However, Dr. Houston Merritt, dean of the Columbia University College of Physicians and Surgeons, says it is still experimental.

L-Dopa is a chemical compound known as an amine. Amines are needed in the transmission of impulses between nerve cells. If amines are absent, cells do not get the proper relays.

Parkinson's disease is a progressive condition. In recent years, many patients have been relieved of tremors by surgery, but there is evidence, says Dr. Merritt, that the improvement is not permanent.



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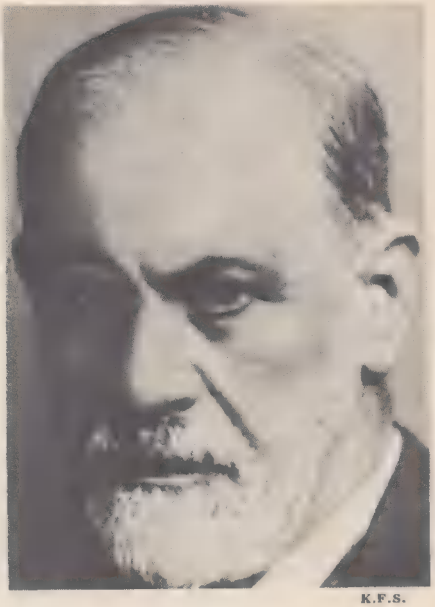

K.F.S.

For years psychiatry in America has been dominated by the theories of Freud (right). Now behavior therapy, based on the work of men like Pavlov (left) is gaining a foothold.

Is neurosis a bad habit?

by Flora Rheta Schreiber and Melvin Herman

At 38 Henry L. was frozen in the lowest echelon of his firm. Depressed that his marked ability in economics and accountancy had gotten him nowhere, he had gone to a psychiatrist. No help. When a friend suggested that he try a "behavior therapist," he complied but without enthusiasm.

Acting more like an employment counselor than a physician, the new doctor helped the man analyze opportunities in his firm. There weren't any. "Quit and go elsewhere," the doctor urged. Henry's fear of approaching prospective employers then became the focus of therapy.

The behavior therapist is, in effect, a "different kind of doctor." At present there are no more than 30 of them in the United States. Most are in New York, Boston, San Francisco, Los Angeles and chiefly in Philadelphia. They point to excellent results among the roughly three to four thousand patients they have treated here, and in England and South Africa.

"Behavior therapy," explains Dr. Joseph Wolpe, who launched it fourteen years ago, "depends on our knowledge of the lawful relations between what casual factors control what effects. We accept nothing until it has been proved either clinically or in the laboratory. Our approach is concrete."

Henry L.'s doctor displayed this practical approach in the way he plunged his new patient into "behavior rehearsals" and "assertive training." First, the doctor enacted the role of an employer while Henry played the applicant. Then the doctor, acting as applicant, demonstrated the way an assertive man would enter an office. He asked his patient to observe the impact of variations in posture and gait, in the absence or presence of eye-contact and in tone of voice. Then he asked the patient to mimic him. The scene was rehearsed until Henry L. could approach the executive-behind-the-desk with no overt signs of timidity or anxiety. A film and tape-recording were then made of the patient's performance so that he could study it objectively. "Sit back," the doctor said, "and imagine yourself an employer. If you were he, would you employ this man?"

After five weeks Henry L. achieved enough self-assertiveness to quit his job. Two months later he became Chief Accountant of a large industrial firm. Five years after that he had become the principal economic advisor to an important mining concern.

A habit of anxiety

To the behavior therapist a neurosis is nothing more than a *habit* of anxiety. (A depression is the result of an anxiety that is unusually intense or prolonged). Unlike psychoanalytic methods, behavior therapy does not deal with repressed complexes or with the Oedipal miasma. Instead, by making a practical frontal attack on behavior itself, it is primarily concerned with effecting immediate change. In effect, it's like teaching. By showing people graphically how to do things, they tend to learn new and more effective habits. When one therapeutic maneuver fails, the therapist tries another. He has a wide range of techniques upon which to draw. Among the "maneuvers," in addition to "assertive training," is "systematic desensitization." In brief, the desensitizaton method consists of dispelling anxiety while a patient

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Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric Hospitals.

Psychiatrists first thought behavior therapy was just "surface stuff." Now they are borrowing the techniques.

is relaxed. When he is able to carry over the lack of anxiety into ordinary life and normal stresses, he is well.

At first psychiatrists looked on with benevolent amusement. To a doctor, whose theories are rooted in Freud and psychoanalysis, Wolpe's approach, growing out of animal experiments and the theories of learning developed in universities, seemed naive, superficial and mechanistic. It appeared to be "surface stuff." Behavior therapy's patients, psychiatrists predicted, would recover only to relapse or to develop new symptoms to replace old ones. Even when Wolpe could point to indisputable successes, the opposition attributed those successes not to behavior therapy itself, but to the doctor's own "therapeutic personality." When therapists with widely different personalities achieved the same results, psychiatrists argued that behavior therapy's successes were undoubtedly due to some inadvertent use of psychoanalysis itself.

Today the voices of opposition have grown fainter. Some psychoanalysts have even borrowed from behavior therapy's range of techniques. Dr. Martin Glick, a psychoanalyst, writing in "The Archives of the Journal of General Psychiatry," admits this debt.

The behavior therapists, of course, have always had strong counter-arguments against the psychiatrists. To the charge that their range of techniques was superficial, Wolpe, along with another pioneer in behavior therapy, Arnold Lazarus, Ph.D. and Director, Behavior Therapy Institute, Sausalito, California, replied that "this opinion presupposes the truth of the psychoanalytic view of the nature of neurosis and there are many reasons for doubting this view." They add, "Behavior therapists rarely encounter anything like relapse and when they do, it is usually quite clear that there has been no real behavior therapy." Wolpe admits to only one relapse among 45 patients followed up two to seven years after the conclusion of therapy.

Personalities change

The answer to the charge that behavior therapy cannot effect personality change is that, "If personality is defined as a person's totality of habits and behavior, it is obvious that the elimination of neurotic habits is in itself a kind of personality change." Who can doubt that Henry L. underwent a personality change?

The behavior therapists also claim more recoveries in shorter time than are achieved through other methods of psychotherapy. They contend that, while psychoanalysis, for instance, requires some 600 ses-

sions on a three-to-four times a week basis for three or four years to cure a neurosis, the behavior therapists accomplish the same result through an average of only 30 sessions.

About 87 percent of 618 neurotic patients Dr. Wolpe has treated have recovered or improved. Moreover, as is indicated by his follow-up study of several patients for seven years after the conclusion of therapy, his patients not only seem to maintain the improvement, but actually to improve further without additional therapy.

Dr. Lazarus reports a recovery rate of 86 percent among patients who had given behavior therapy "a fair trial" and a 100 percent recovery rate among a group of 18 children he treated in 1960 for phobias. These children, moreover, recovered in an average of ten sessions.

Dissolving phobias

Phobias are specific pathologic fears which are out of proportion to the apparent stimulus. At times these phobias can be rapidly and dramatically dissolved by searching out the initiating experience of the first manifestation of a symptom. Not all phobias, however, have such a well defined onset. Those that don't probably respond better to behavior therapy than to psychoanalysis.

"Systematic desensitization" is one of the major techniques used in the treatment of phobias. The most common form of desensitization involves deep muscle relaxation. Stimuli are placed in ascending order. The patient is given training in progressive relaxation. Deep muscle relaxation has effects that are the exact opposite of those that evoke anxiety.

When relaxation is complete, desensitization begins. The therapist presents a scene for the patient to imagine. Don, who is claustrophobic, for instance, heard his doctor say, "I am going to ask you to imagine a number of situations which will not disturb your present calm. If, however, you are disturbed, raise your hand. Think only of relaxing your muscles. Enjoy yourself. Now imagine you are sitting in your living room, serenely reading your newspaper. A headline, 'Man trapped in a mine,' stares at you. Nothing disturbs you."

The patient was then told to stop imagining the scene and to relax. The same scene was again presented for about the same length of time. There was a third presentation of the same scene. Don hadn't raised his finger and the therapist was able to present the next scene in the confident expectation that before long the anxiety reaction would descend to zero. What the patient can accept in imagination without disturbance, he can also endure without disturbance in real life. According to Dr. Wolpe, 90 percent of the cases treated by desensitization were either apparently cured or markedly improved. Don was one of them. Even though he was assigned to a cubby hole of an office at the bank

When a patient can learn to accept a situation in his imagination, he can learn to accept it in life.

where he works, he was calm and content.

Good results have been achieved not only with occupational problems like Henry L.'s and with phobias like Don's, but also with patients suffering from sexual problems—both male impotence and female frigidity—with inhibitions, with social anxieties and with stuttering.

Helen B., for instance, had become a virtual recluse. Even a small dinner party for close friends found her so ill at ease that her hand trembled when she lifted a teacup. Disregarding *why* she was afraid, her behavior therapist rehearsed social situations with her. Together they would repeatedly raise first an empty cup and then a progressively fuller one. They did this until all signs of shaking disappeared. Later they repeated the sequence before an audience. After that Helen could attend dinner parties, without trembling.

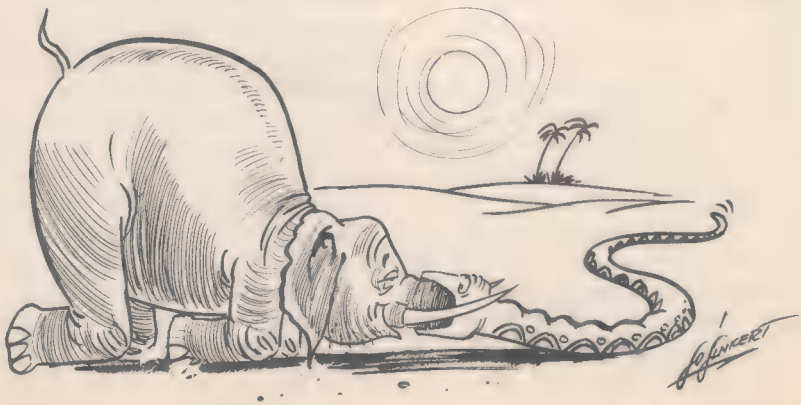
The tremble in the voice, the hesitation, the blockage of speech known as stuttering can also be removed through behavior therapy. When, for instance, Michael N., a stutterer, consulted behavior therapist Dr. Joel Brady, Professor of Psychiatry at the University of Pennsylvania School of Medicine, this 12-year-old boy was in for a few surprises. He was instructed to read in an exaggeratedly slow and relaxed manner, was told to respond to the blocks in his speech by relaxing and speaking slowly so as to avoid increased muscular tension. A chronic stutterer, he found it very difficult to follow these seemingly simple restraining rules even though the therapy sessions were short. Whenever he violated the rules by speeding up or tensing, the therapist brought him back in line by flashing a red light from a photographer's electronic flash gun. Stopped and relaxed by the light, Michael then proceeded to speak as slowly as the rules required. Michael also found himself pacing his speech, one syllable to each beat, with a metronome used for piano practice. When he achieved nearly 100 percent fluency or some 60 beats a minute with slow speech, he had to time each syllable of his speech with the regular, rhythmic beat of the miniature electronic metronome that Dr. Brady wears behind his ear. Like most stutterers, Michael, under the metronome treatment, showed a striking increase in fluency. Gradually his stutter, except under exceptional stress, disappeared.

The therapist is not content, however, to work only with the complaint that brought the patient to therapy. The stutterer, for instance, is likely to be treated by what is called "deconditioning of social anxiety" so that the discom-

fort that may be present even when he does not have to speak is removed along with the stutter. "We put our main emphasis, however," Dr. Wolpe declares, "on the patient's most pressing current problem. Thus, if a man who is acutely upset by his sexual inadequacies also has a fear of d e l i v e r i n g speeches, the former complaint will receive attention first. It is possible for these to be interrelated."

Behavior therapy was designed for the treatment of neuroses and not the serious forms of mental illness called psychoses. In general, behavior therapists have refused to treat psychotics. Nevertheless Dr. Wolpe told us "Our techniques, while not suitable for the cure of psychotics, have been used to modify their behavior."

With the increasing recognition in the United States that emotional illness is best treated by psychotherapy, behavior therapy can assume an increasingly important role. This is so even though middle and upper class patients just naturally expect their therapy to be psychoanalytic. Once, however, the two techniques are stripped bare of their fundamental beliefs, they may have more in common than one might at first suspect. Both take case histories, make diagnoses, consult with the people who are most important in the patient's life and use testing as an objective form of appraisal. For both, too, the measure of success is a realistic one. The psychoanalyst does not declare a patient well because that man or woman has "worked his way through the Oedipal constellation," but because he has begun to function well. Nor does the behaviorist ask in the end whether his patient has unlearned bad habits. "We know we have succeeded," says Wolpe, "when the patient, without the aid of drugs or other crutches, is at ease in situations in which he was formerly disturbed."



The oldest medicine—wine

In ancient days, wine was medicine for all ills. Today, man is again deciding it's a more pleasant remedy than many "wonder" pills.

by Theodore Berland

TODAY, thanks to disenchantment with the pills which we gulp by the millions, and to modern research, wine is regaining its standing as a therapeutic aid.

Wine was man's most common medicine for all sorts of ailments for millennia; and for centuries, was served as the base for other healing ingredients. Then, in the 13 years of national prohibition, wine and other alcoholic beverages went into obscurity, re-emerging at a time when drugs were getting dramatic attention because of their use against specific diseases and conditions.

Viewed in the more objective light of modern, scientific research, wine is reappearing for the help it can give in control of many pathological conditions and in the care of many kinds of hospitalized patients.

Wine is more than grape juice, fermented so that it contains about 12 percent alcohol. It is, in fact, a complex liquid that is full of various simple and complicated ingredients. From the pharmacological effects of its unique components comes its value as a medicine.

Among the vitamins in wine, there is only a tiny amount of vitamin A, but significant enough quantities of the B vitamins so that wine can be considered a supplementary source. Among the minerals present is iron, 80 percent of which is in the ferrous form that can be readily absorbed by the body. Among the pigments that give wines their characteristic clear colors are the anthocyanins, which have definite antibiotic action.

Of course, wine contains alcohol. This alcohol has its own effects on the body, and so do the other components. They slow the absorption of alcohol from the digestive tract into the blood stream. This means that wine can produce and maintain a relatively low and safe blood-alcohol concentration.

This is one reason why wine serves as a tranquilizer for adults. Writing on the subject in the *Illinois Medical Journal* last year, Dr.

Salvatore P. Lucia, professor of medicine at the University of California Medical Center in San Francisco, said wine is also the most pleasant and effective of medicines. "The astute physician is always aware of the salubrious effects of wine. Carefully-timed and well-chosen, it can be appealing indeed to the taste and senses, thus it is of far more value as a therapeutic adjuvant in promoting relaxation than is a hastily swallowed capsule." He recommends a dose of one serving (4-ounce) or two with meals.

Because it calms nerves, wine is also useful for dieters. Dr. Georgio Lolli, of New York and Rome, found that a glass of dry table wine taken about a half hour before mealtime or with the major meal of the day helped obese patients lose weight. The caloric expense of the wine—about 90 calories per 4-ounce serving—was well worth it. The tranquilizing effects reduced the emotional tensions that compelled these overweight people to eat and helped them sleep better when used before bedtime.

In their recent book on *Alcoholic Beverages in Clinical Medicine*, Drs. Chauncey D. Leake and Milton Silverman, prominent California pharmacologists, reviewed the clinical conditions in which wine was effective. In particular they emphasized its euphorious value for hospital and nursing-home patients.

Furthermore, says Dr. Leake, wines are helpful in heart disease and high blood pressure and "enable oldsters to discount comforts and unpleasant sensations, ignore the actual or apparent ingratitude of children and adapt themselves to a disquieting or even frightening environment."

Other values include its use as a dietary source of iron in iron-deficiency anemia, a source of energy for diabetics because it requires no insulin to burn, and as a way to stimulate sluggish kidneys. Something in wine, too—probably its many enzymes—can make it ideal for patients who have the Malabsorption Syndrome. In this malady, which can occur after intestinal surgery and in older people, fats are not absorbed from foods. In some cases, wine restores fat absorption to normal.

"Oh, I just couldn't adjust to a people oriented society."

Dozens of identical plaster skull models? Look again. One ambitious comparative anatomy freshman at New York University College of Dentistry gave his project individuality.

Those speedy dinosaurs

PICTURE YOURSELF standing there at the edge of a forest, 100 million years ago. Suddenly you are spotted by a passing dinosaur. It turns and comes after you—at 30 mph!

Wait a minute, you say, there is something wrong here. Dinosaurs are reptiles, they should be slow and sluggish. How come this one is moving like an express train? Because they had a "mammal-like posture" and "achieved locomotory advancements long before the mammals," says Robert T. Bakker, a researcher in *Yale University's Peabody Museum of Natural History.*

In reconstructing the lives and habits of dinosaurs, Bakker has produced evidence that challenges the traditional theory that the dinosaurs were as slow moving as most modern reptiles. He has focused his studies on "the anatomy and mechanics of the forelimbs of living vertebrates and attempted to interpret the forelimb movements of fossil forms, especially dinosaurs."

Bakker has recently completed a two-year study of dinosaurs.

Here are some of his other conclusions:

1. Posture: "The accepted restorations of dinosaurian posture are incorrect" when they show the hindquarters held high and the forelimbs sprawled close to the ground "like a man cheating at pushups." He says the bones and muscle and joint action actually indicate "a posture fully as erect and graceful as that of a mammal, both fore and aft."

2. The circulatory system: "Dinosaurs may well have had four-chambered hearts fully as efficient as those of birds and mammals" and "probably vital to a high level of activity." Only crocodiles, among modern reptiles, have a four-chambered heart. Bakker believes that dinosaurs were far more advanced than most modern reptiles.

3. The sauropods: The largest of the dinosaurs, the sauropods, the group which contained the huge, long-necked, long-tailed creatures like *Brontosaurus*, are traditionally pictured as rather weak water-loving monsters, whose legs were incapable of holding up their huge bodies on land for an extended period. Not so says Bakker. These great dinosaurs "had short bodies with usually quite long legs and deep slab-sided chests," not at all like water-living hippos or rhinos. Their limbs were evolved for "elephant-like" locomotion "over firm, hard ground," and their long necks and special teeth were adapted for ranging widely to pull up grasses and tear off branches.

Among Bakker's other points about sauropods: Their tails probably helped them to swim and could be swung "like enormous whips" for defense; their foraging herds must have decimated forests; and when groups of sauropod footprints are found, the smallest ones are found, "only in the center of the herd," where the young were pro-

Dr. Henry M. Sobell, associate professor of chemistry at the University of Rochester, makes an adjustment on the computer-controlled X-ray diffractometer he uses to examine crystals of the base-pair compounds in DNA, the chemical basis for genetic coding.

tected from predators. Herd behavior is unknown in modern reptiles.

4. The ceratopsians: These are the horned dinosaurs, and the last group to appear. The early ones had front legs and hind limbs adapted to galloping, says Bakker, and some could probably run on two legs at full speed.

Even the largest ceratopsians (up to 10 tons and 30 feet long) had limbs "built for very fast, quadrupedal galloping" at speeds "probably up to 30 mph." With their long horns and quick-moving heads, Bakker suspects that they must have been among "the most dangerous terrestrial herbivores ever to have evolved," and capable of putting to rout even the massive, carnivorous tyrannosaurs.

Bakker believes that the speed and agility of the dinosaurs was one of the reasons for their great success. We tend to think of them as evolutionary dead ends which died out. They did but only after they had reigned over the earth for 100 million years.

5000-year-old teeth

This year a sealed building near the pyramids of Giza was opened to give *University of Michigan* scientists a chance to X-ray some very old teeth. The building is a repository for the mummies of about 500 priests and nobles who were buried near the pyramids during the 4th, 5th and 6th Dynasties, 2680 to 2258 B.C. They were found some 60 years ago, and placed in a huge stone building at Giza. They are kept sealed by the Egyptian government and only opened for approved scholarly purposes.

The Michigan research group headed by Dr. James E. Harris took "cephalograms" — biometric X-rays of the face, teeth and jaws of the mummies.

In March 1965, Dr. Harris started collecting cephalograms of ancient Nubians from burial grounds up the Nile River near Abu Simbel. On subsequent expeditions he X-rayed the royal mummies in the Cairo museum and the living descendants of the Nubians.

DDT—indiscriminate killer

DDT, even in minute amounts, can cripple the tiniest sea organisms. One part DDT in ten million of sea water is enough to reduce activity of phytoplankton, the microscopic plant life of the sea, to 10 percent of normal. The unicellular organisms form the basic foodstuffs for all sea life from oysters to whales and produce two-thirds of the world's atmospheric oxygen supply.

These alarming findings were reported by Dr. Charles F. Wurster Jr., from *the State University of New York at Stony Brook.*

Wanted: 300,000 technologists

BY THE END of this year, according to the Engineering Manpower Commission, a total of 136,000 students will have graduated from engineering schools since 1965. But industry will need more than 200,000 such newcomers. And by 1975, the decade's cumulative available graduates will have jumped to 440,000. But the need will be for 740,000—a gap of 300,000! The same trend is evident not just for engineers, but for scientists and technicians as well.

In short, the scientist, engineer and technician is going to find himself in a ripe, lucrative and highly satisfying field for the foreseeable future. Why aren't more young people rushing in to fill the vacuum?

"There's often a lack of interest on the part of the student because he doesn't understand what engineering and technology are all about," says David Reyes-Guerra, executive director of the Junior Engineering Technical Society.

For many, the image conjured up by these labels is one of nuts, bolts, bridges, concrete power dams and blueprints, explains Paul Robbins of the National Society for Professional Engineers. "It's an antiquated concept."

How many people know, he points out, that engineers made heart transplants possible; that satellites, computers, space ships, space exploration plans, nuclear power, archaeological discoveries and hundreds of other fascinating and exciting fields today are based on the work of modern engineers?

Along with these gentlemen, Johnson O'Connor, whose Human Engineering Laboratory contains one of the largest banks of statistical information in the world on human aptitudes, stresses the need for recognizing and doing something about technical aptitudes early. In a recent report, the laboratory reveals some sad facts. People high in vocabulary and structural visualization (among the aptitudes of successful scientists, engineers and technicians), often are tempted by the status and glamour of administrative and executive positions in the business world. Intelligence and other aptitudes make them likely candidates, so they abandon the satisfaction of their structural visualization aptitude. Four out of five of those who do this, says the report, turn from executive jobs as they approach 40 in order to satisfy that unrequited "structure," and fail to gain by the move. It's too late! Therefore, young men high in structural visualization attracted by executive jobs in big sales organizations must plan from the beginning a different life beyond 35 or 40. The thing is that status, pay, excitement and glamour can be just as great for the man with the right aptitudes in the profession that really satisfies him. And it's going to be more so!

Unhappily, unless he recognizes his goal during early high school years, a student is too late to meet the requirements of engineering or technical colleges.

How can a student find out in time? Aptitude testing is one sure way. If the tests point to a successful career in science, engineering and technology, proper groundwork can be laid. Schools and proper course work will do the rest.

There's another growing "proving ground" for a suspected interest in applied sciences and engineering. In 1,200 high schools across the land, some 30,000 students have formed clubs under the banner of the Junior Engineering Technical Society, Inc. (JETS). This nonprofit educational organization, founded in 1950, sponsors an extracurricular program for high-schoolers interested in science, engineering and technology. They hold regular meetings under the supervision of faculty advisors; they design and build projects and exhibit them at fairs, trading information and knowledge acquired in the process.

It doesn't take long for a student to determine whether or not this is the field for him. "The JETS program helps a young man to prepare for the professional college," says Reyes-Guerra. "We have a proven record of acceptance and success of JETS students in colleges."

In order to help perform a service for those of its readers who hope to aim for careers in engineering and the sciences, *Science Digest* will carry a series of informational articles. Next month you'll find one that tells where a student starts to find out what fields need him, and what he must do to chart his course.

—R. F. Dempewolff

The new flying machines

THE BELL POGO and the Flying Chair can carry one or two men, standing or sitting, for several miles through the air. The machines are expected to be especially useful to soldiers, policemen and firemen, because at the end of a flight they are free for action.

The rocket belt, developed earlier by the same concern, Bell Aerosystems Company, a Textron subsidiary in Buffalo, N.Y., gives one man a swift trip, but he lands with the equipment still on his back.

The new flying platforms, powered by kerosene turbojets, will also have greater range, moving for minutes instead of seconds. The company is developing the turbojet engine under contract with the Defense Department's Advanced Research Projects Agency. It is also preparing for tests a flying belt with a turbojet in the back pack.

Pending perfection of the new engine, the inventors, Wendell F. Moore and Edward G. Ganczak, have already flown versions of the Pogo and Flying Chair using hydrogen peroxide rockets.

Mr. Moore, assistant chief engineer for Bell, invented the rocket belt and first flew it in 1961. In designing the new platforms, for which they recently received Patent 3,381,917, he and Mr. Ganczak made sure the passenger or passengers would remain in a relatively constant position, without being strapped down, so that the thrust of the engine would always pass approximately through the center of gravity. The men sit or stand on the fuel tank, which is bigger than they could carry in a pack.

In both the Pogo and Chair forms, arm rests are provided that enable the pilot, by pivoting around, to direct the nozzles for best lift and propulsion.

The company conducts aerospace operations in Tucson and Fort Huachuca, Ariz., Cleveland and Toronto.

—Stacy V. Jones

K.F.S.

Modern technology has made this fine old Danish schooner virtually obsolete, but our knowledge today of the ocean beneath it is still very limited.

How deep is the ocean?

by John and Molly Daugherty

THE formation of the International Oceanographic Commission under the United Nations recognizes the need for international cooperation in ocean research.

How much do you know about oceanography?

1. The total surface of the earth covers about 197 million square miles. The area that the sea water covers is about
   a. 100 million square miles
   b. 140 million square miles
   c. 160 million square miles
2. The first expedition planned by the Intergovernmental Oceanographic Commission took place in the
   a. Atlantic Ocean
   b. Pacific Ocean
   c. Indian Ocean
3. The deepest sea water is found in trenches. So far, the greatest depth

measured is in the
   a. Mariana Trench
   b. Mindanao Trench
   c. Tonga Trench

4. The continental shelf slopes off gradually about 10 feet a mile. Beyond that, the slope is steeper. It averages about 400 feet a mile. An extreme exception—a 45-degree slope—occurs off the
   a. East coast of New England
   b. East coast of Ceylon
   c. Coast of England in the North Sea

5. Although efforts to survey the oceans' vast area have increased in the past 20 years, we have accurate maps for only about
   a. 1-2 percent of the ocean floor
   b. 8-10 percent of the ocean floor
   c. 22-25 percent of the ocean floor

6. At the end of summer clean sand seems abundant on many beaches. Yet next spring coarse cobbles cover the same beaches because
   a. Winter storms wash the cobbles in
   b. Sand penetrates the beaches and exposes the cobbles underneath
   c. The violent backwash of storms takes the clean sand away

7. Discovery of the Mid-Atlantic Ridge from Greenland to the Antarctic was of major importance, especially when the geologists at Lamont Observatory found that this is only part of a worldwide chain. The length of this worldwide chain is about
   a. 25,000 miles
   b. 40,000 miles
   c. 55,000 miles

8. The continental shelf averages about 40 miles in width. The total area of the shelf of shallow water is about
   a. 2 percent of the total sea area
   b. 7 percent of the total sea area
   c. 11 percent of the total sea area

9. In 1964 several private U.S. oceanographic institutions agreed to cooperate in deep-sea drilling. In 1965 the vessel "Caldrill" drilled in six locations off Jacksonville, Florida. Drilling into the sea bottom just 22 miles from Jacksonville, the research team found
   a. Oil
   b. Salt
   c. Water

10. Since World War II ten fracture zones or series of great cracks in the sea floor have been located. Both vertical and horizontal movement has occurred along them. These faults are in the
   a. Pacific Ocean
   b. Arctic Ocean
   c. Atlantic Ocean

Answers:

1—b One hundred and forty million square miles. Sea water covers 71 percent of the earth.

2—c Indian Ocean. Forty-five ships from fourteen countries made more than 150 cruises in the Indian Ocean in 1963-1964. This ocean was selected because so little was known about it. Echo sounders and associated electronic devices trace the shape of the ocean bottom and record the depth under the moving ship. A wide variety of measurements such as temperature and salinity of water, detection of ocean currents, sampling of sediments, and biological investigations take place.

Another expedition into the tropical Atlantic with seven countries cooperating started in 1963. This differed in that each ship took the same measurements along parallel lines north and south of the Equator at the same time. This gave a general total view of a relatively large area without the possibility of changes occurring over an extended period.

3—a Mariana Trench. The Soviet ship *Vityaz* measured the depth 36,-

204 feet in 1959. The Tonga Trench, measured by the U.S. research vessell *Horizon* in 1952, is 34,884 feet deep. The Mindanao is about 34,440 feet deep. Earthquakes of deep origin occur in the areas of the trenches.

4—b The east coast of Ceylon. During the international Indian Ocean Expedition the ship *Pioneer* in 1964 observed a change in depth of water from 1,095 fathoms to 472 fathoms within 3.1 minutes while cruising at 12 knots. This is a change in depth of 3,788 feet while travelling horizontally 3,648 feet—a slope of about 45 degrees. A few soundings off the southern coast of Cuba may indicate another exception to the averages.

5—a One to 2 percent of the total area. These maps are mostly for coastal areas important to shipping. Even so, some shipping lanes are inadequately charted. Between the Panama Canal and Key West shipping lane the survey ship *Explorer* as recently as 1960 discovered an undersea mountain (not found on any map) at a depth of 90 feet.

6—c The violent backwash of storms takes the sand away. The winter storms in the northern hemisphere produce high waves which put the sand in suspension and carry it seaward. In summer storms the more gentle waves cause a less violent backwash, and clean sand is left on the beach.

7—b Forty thousand miles (15,000 more than the circumference of the earth). The ridge extends through the Indian Ocean and also the eastern Pacific onto the land in western North America. At least part of the ridge has a narrow rift or valley along the middle. We need more surveys, however, before full and accurate details are available.

8—b Seven percent. The depth at the outer edge of the continental shelf averages about 420 feet. The origin of the shelf is not known. The theory that the shelf came from sediments was discarded when sampling did not show that coarse sediments were inshore and finer ones, farther out. Sometimes the reverse was true. Probably shelves in various regions have different origins.

9—c Water. Two freshwater aquifers beneath the sea gushed forth artesian water 30 feet into the air. This find added to the water resources of Florida. Drilling also disclosed rich beds of the mineral phosphorite of commercial value.

Drilling included holes as far as 250 miles from shore in water 3,500 feet deep. The deepest drilling was 1,050 feet below the ocean bottom.

10—a Pacific Ocean. The Mendocino fault is a part of one of the fracture zones. It lies off Cape Mendocino, California. Scripps Institution of Oceanography geologists find from magnetic evidence that the bottom of the ocean north of this fault has moved west 750 miles with respect to the ocean bottom south of the east-west fault line.

Score Yourself:

9—10 right—You have oceans of knowledge.

4— 8 right—You kept afloat.

0— 3 right—You were at sea.

Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the Science Digest staff.

The greatest scientist ever

Who, in your opinion, was the greatest scientist who ever lived?

If the question were, "Who was the second greatest scientist?", it would be impossible to answer. There are at least a dozen men who, in my opinion, could make a claim to second place. Included, for instance, would be Albert Einstein, Ernest Rutherford, Niels Bohr, Louis Pasteur, Charles Darwin, Galileo Galilei, Clerk Maxwell, Archimedes and others.

In fact, it is very likely that there isn't a second greatest scientist at all. The claims of so many are so good and the difficulty of distinguishing levels of merit are so great that we might end up by declaring, say, a 10- or 12-place tie.

But since the question is, "Who is the *greatest?*", there is no problem. I feel that most historians of science would declare at once that Isaac Newton was the greatest scientific mind the world has ever seen. He had his faults, heaven knows; he was a poor lecturer, something of a moral coward and self-pitying sniveler, and was at times subject to serious breakdowns; but as a *scientist*, he has no equal.

He founded higher mathematics by working out the calculus. He founded modern optics by his experiments on breaking up white light into the colors of the spectrum. He founded modern physics by stating the laws of motion and deducing their consequences. He founded modern astronomy by working out the law of universal gravitation.

Any one of these four feats, taken by itself, would have been sufficient to show him to be a scientist of major importance. All four, taken together, put him in

first place without any question.

Nor are his discoveries all there is to say about Newton. His manner of presenting them was even more important.

The ancient Greeks had put together a formidable collection of scientific and philosophic thought. For two thousand years names such as Plato, Aristotle, Euclid, Archimedes and Ptolemy had towered like giants over the generations that followed. The great thinkers among the Arabs and Europeans harked back to the Greeks and scarcely ever dared advance any notion of their own without buttressing it by a reference to the ancients. Aristotle in particular was the "master of those who know."

In the 16th and 17th centuries, a number of experimenters such as Galileo and Robert Boyle demonstrated that the ancient Greeks did *not* have all the right answers. Galileo shattered Aristotle's notions about physics, for instance, doing the work that Newton later summarized in his three laws of motion. Nevertheless, Europe's intellectuals still dared not break away from the long-idolized Greeks.

Then came 1687 when Newton published his Latin-Language "Principia Mathematica" (the greatest single scientific book ever written, in the opinion of most scientists). In it, he presented his laws of motion, his theory of gravitation and many other things, making use of mathematics in the strict Grecian style and organizing everything in the most faultlessly elegant manner. Those who read the book had to admit that here, at last, was a mind that was the equal or superior of any of the ancients, and that the world-picture he presented was beautiful, complete and infinitely superior in rationality and inevitability than anything in the Greek books.

With that one man and book, the hold of the ancients was smashed and modern man's intellectual inferiority complex was forever broken.

After Newton's death, Alexander Pope said it all in two lines:

"Nature and Nature's laws lay
hid in night:
God said, Let Newton be! and
all was light."

—Isaac Asimov

What is an allergy?

Allergy is an abnormal reaction of the body to an outside substance. These substances, called allergens, may be taken into the body through the nose and lungs (pollens, house dust, animal dander), by mouth (foods and beverages) and through the skin (by contact with woolen clothing, animals, rugs, insect bites). An allergic person is said to be sensitive to one or more of these substances.

The most common symptoms produced by allergy are hay fever,

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According to this publisher, many people do not realize how much they could influence others simply by remembering accurately everything they see, hear, or read. Whether in business, at social functions or even in casual conversations with new acquaintances there are ways in which you can dominate each situation by your ability to remember.

To acquaint the readers of this publication with the easy-to-follow rules for developing skill in remembering anything you choose to remember, the publishers have printed full details of their self-training method in a new booklet, "Adventures in Memory," which will be mailed free to anybody who requests it. No obligation. Send your name, address, and zip code to Memory Studies, 835 Diversey Parkway, Dept. 690-018 Chicago, Ill. 60614. A postcard will do.

asthma, eczema and chronic "stuffy nose." The tendency to become sensitive or allergic to otherwise harmless substances is usually inherited. Whether one does become sensitive or not depends in part to what one is exposed to and how much exposure he undergoes. It is not uncommon for an infant to become sensitive to cow's milk shortly after birth. Throughout his life this individual may have new sensitivities as he undergoes new exposure. Some old sensitivities may even be lost.

In a sense allergy is the body's overreaction. The body is geared to protect itself from the invasion of any foreign substance. In a complex, and as yet ill-understood way, the body's immune system begins to react against harmless substances in the allergic individual.

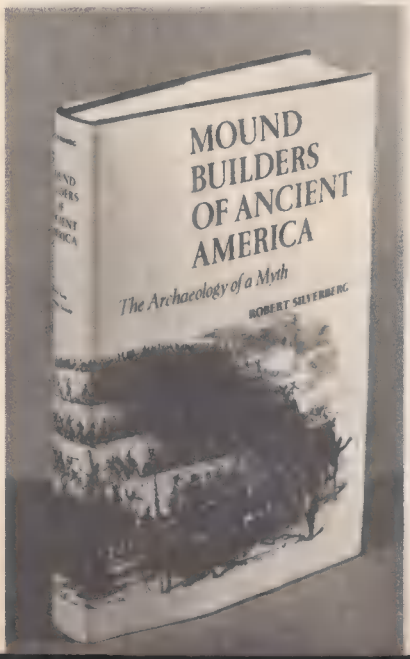
Allergies can range from mild to extremely severe and even debilitating. Fall hayfever season is pure agony for many sufferers.

Doctors use two chief ways to treat allergy. One is to remove the cause of the allergy insofar as practical. The second is try to build up the patient's resistance to the offending allergens by injecting increasing amounts of extracts made from them at regular intervals. Allergy is not "cured" in the strict sense of the word, but it can be kept under control so that it does not produce any symptoms. (Information on allergy may be obtained by writing to Allergy Foundation of America, 801 Second Avenue, New York 17, N.Y.)

'Lost' race not lost at all

Mound Builders of Ancient America. Robert Silverberg. New York Graphic Society. ($8.95).

North America is poor in ancient ruins. But when Europeans began pushing their way into the valley of the Mississippi, they encountered large numbers of great earthworks or mounds. These were obviously man-made, but which men had made them? And why? Lacking a long and glorious past for their new homeland, some men began to construct one around these mounds. By the 19th century, the imaginative fantasies that had been woven about a mysterious "lost race" of mound builders had assumed bizarre and even monstrous proportions. The mounds were attributed to virtually every race that ever existed on this earth, and several that have never existed at all. A composite "mound builder," according to Robert Silverberg, would have been a "giant white Jewish Toltec Viking." He might have added, "from Atlantis."



What made all this fantasying truly strange is that virtually all the evidence, including the accounts of the earliest white men to encounter the mounds, indicated very clearly that the origin of the mounds was the most obvious possible—the Indians built them.

Yet a lot of people went to the most elaborate lengths to deny this. In their zeal to provide America with a glorious past, unrivalled by anything in the Old World or South America, they had grossly overestimated the technical achievement the mounds represented. Worse though, was the belief, held by all too many whites, that the Indians were nothing more than the most primitive form of savages. It was comforting, perhaps, to believe that the red man, who was being wiped out in the most savage possible way, had once done the same sort of thing to a great race of "mound builders" who had preceded them on this continent. Since the mound builders (like any other advanced people) were always held to be white, the act of genocide against the Indians could be looked upon as an act of revenge instead.

Of course the whole "lost race" idea was utter nonsense, but it is astonishing how long it persisted, and what strange forms it took. Robert Silverberg, a veteran writer on archaeological subjects, does an excellent and comprehensive job of presenting not only the real facts about the mound builders, but the facts about the entire grotesque controversy that surrounded the mounds.

The book is well produced, and filled with excellent illustrations, which really do illustrate points made in the text. If there can be any complaint, it is that Silverberg is a bit too generous. He tells more about the mound builders than the average reader really wants to know. But Silverberg carries his story of the archaeology of the mound builders along in a lively, and thoroughly understandable fashion. The size of the book should not discourage the reader. He will be amply rewarded by getting a good hard look at a long forgotten aspect of American civilization.

—*D.C.*

Other new books of interest

Light and Electricity in the Atmosphere. Hal Hellman. Holiday House. ($4.50). Here's an enlightening book that takes a look at assorted strange and sometimes frightening atmospheric phenomena such as lightning, "St. Elmo's fire," auroras. UFOs, plasmas and ball lightning are not overlooked, either.

The Marvelous Animals. Helena Curtis. The Natural History Press. ($5.95). Although most people dismiss the protozoa without a second thought when discussing the animal world, here is a book that will make this low creature seem more than just "a shapeless bit of ooze" to be seen only under the microscope. The author has a true appreciation for the fantastic array (thirty thousand species) and surprisingly complex structures of these creatures.

An American Genius. Herbert Childs. E. P. Dutton & Co. ($12.95). A thorough account of a physicist, Ernest Orlando Lawrence, whose life had a profound effect on modern science. A Nobel Prize winner in his thirties, creator of the first cyclotron, a leader in developing the first atomic bomb and a pioneer in development of radioisotopes for medical and industrial use, Lawrence was an American genius.

Science, Numbers, and I. Isaac Asimov. Doubleday. ($4.95). Probably no more popular writer of science and science fiction exists in America today than Isaac Asimov. Reading any of his vast number of articles, books or essays, 17 of which are included in this book, is proof of why this is so. Here is another of his volumes, fascinating to read, and highly entertaining.

The Promise of Space. Arthur C. Clarke. Harper & Row. ($8.95). Outer space seems to be one of the most popular topics for writers today, and surely Arthur C. Clarke is a specialist in this field, with countless works to his credit. This one deals with the promise of what's to come in the '70s and beyond.

Man and the California Condor. Ian McMillan. E. P. Dutton & Co. ($5.95). Bullets, poison and official indifference are responsible for the near-extinction of North America's largest bird, according to the author. In 1967, only about 40 condors remained in remote parts of California. Can the big bird be saved? Mr. McMillan, a California rancher, thinks so, and his account of man's depredations may make you mad enough to join the efforts to preserve the condor.

Galileo: Man of Science. Edited by Ernan McMullin. Basic Books. ($15.00). Here are the controversies, achievements, contributions of the "father of modern science," as seen through the educated opinions of 23 leading authorities on the man. Thorough appendices are included.

A Field Guide to the Mammals of Britain and Europe. F. H. van den Brink. Houghton Mifflin. ($7.50). A comprehensive, illustrated guide to over 200 species of mammals in Britain and Europe.

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LETTERS

Intellectual effect on sleep learning

In the article, "Sleep learning" (March '68), it is mentioned in a couple of the experiments that only subjects of "above average intellectual capacities" or who were "very intelligent" were used. Is it not possible that this would have the opposite effect of the one intended by the experimenters and actually bias the experiments away from sleep learning? In a truly scientific experiment, shouldn't a broad intellectual spectrum of subjects be used?

VINCENT C. SCHNEIDER
Ravenna, Ohio

This is being done now.—Ed.

Commentary on 2001

In reference to the article, "How They Made 2001," in the May '68 issue, I have one comment to make. I can see why the author, Richard Dempewolff, concluded the article by saying that you will have to go see the movie for yourself to see how it ends. I went to see that movie. I think the photography is most outstanding, but I didn't understand the ending either.

LEONARD J. SEITZ
Denver, Colo.

Welcome aboard.—Ed.

Solution to transplant problems

The legal and moral problems of human heart transplants (April '68) may soon be obsolete. In a recent talk at M.I.T., Dr. Adrian Kantrowitz suggested that once a reliable artificial heart is available, there will be no need for human heart transplants.

FRED P. DAVIDSON
M.I.T., Class of '69
Cambridge, Mass.

Not enough LSD evidence

Knowing the bent of the conservative mind to reject anything new or different, it would have added credibility to the article on LSD (April '68) if the psychological make-up of the three doctors had been included.

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In red type it said, "The possibility exists that LSD can produce chromosome damage." You can hardly deny that until proved absolutely, the same could be said about, say, cabbage, tight shoes or a runny nose.

I am 50 years old and have never used pot, LSD, etc. I have only become interested in facts about the mindbenders because of the loud outcries from the conservative and right-wing elements of society. It seems that the more extreme the political view, the louder the crying.

Truthfully, from an analytical standpoint, only the naive would be convinced by your article. The young people of today certainly aren't as naive as our older generation.

I buy your magazine to learn, but I think you failed to convey constructive information this time.

LOWELL T. SUDDUTH
Tampa, Fla.

Evidence enough

I read "LSD and Broken Chromosomes" in your April '68 issue, and I would like to tell you how much I liked it. It really made me realize what something like LSD, or any drug, can do to your system.

I only wish everybody, especially teenagers, could read it, because I'm 16, and I know after reading it I wouldn't even go near it.

BARB LUGOWSKI
Excelsior, Minn.

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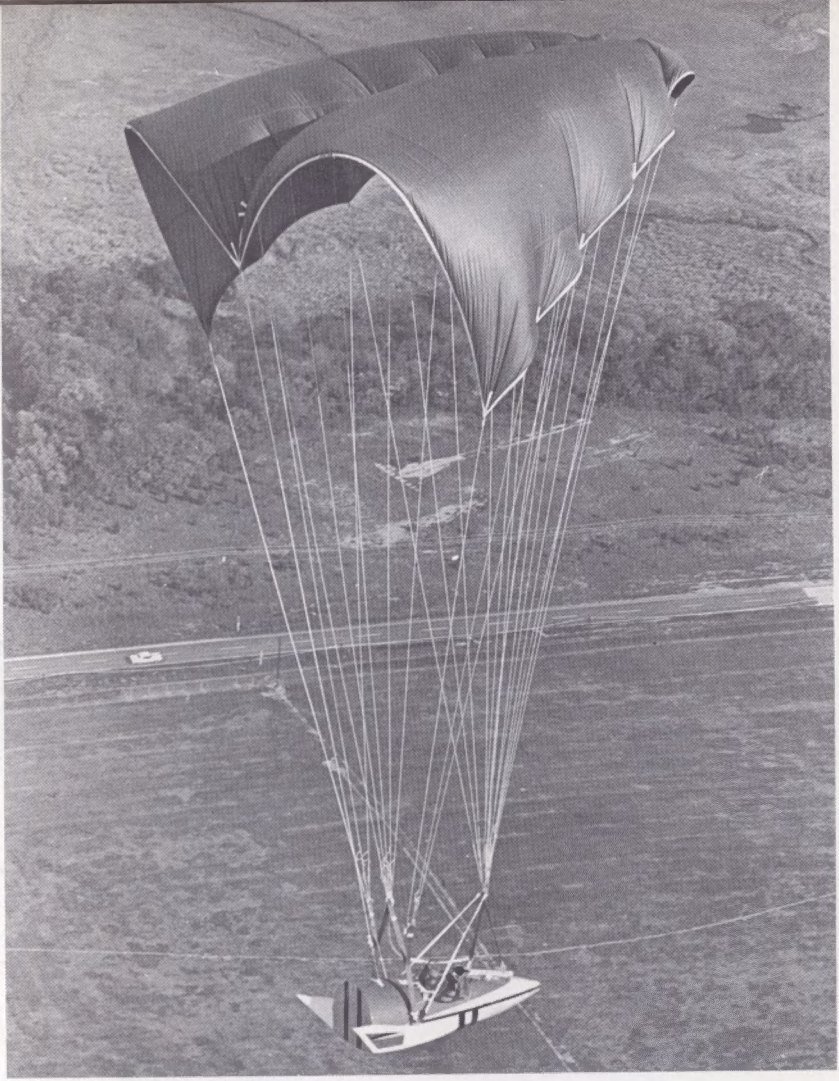
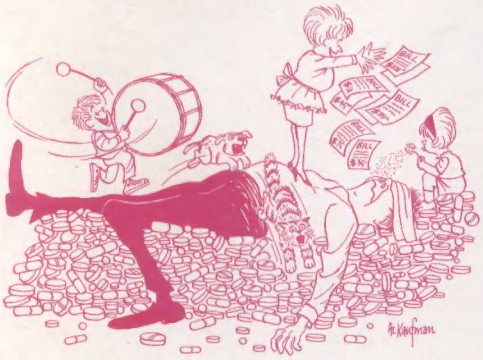


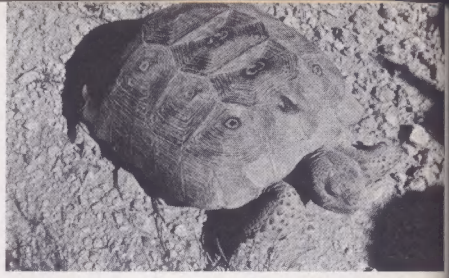
The promising parawing

WHEN FUTURE spacecraft are returned to earth it may be by means of a huge delta-shaped parawing. The device is considered so promising because it can be "flown" to a spot landing like a glider, either from the spacecraft or remotely from the ground. Currently NASA is testing parawing flight behavior during controlled gliding flight and landing touchdown by means of a scale model, fully instrumented, radio-controlled, lifting body parawing model.

In this issue . . .



There are plenty of good reasons for getting a headache. So many that Americans spend $400 million a year trying to get rid of them. For a new look at the underlying causes of headaches and the effectiveness of the various common remedies, see the full story beginning on page 17.

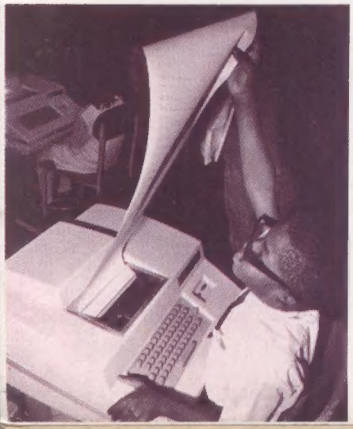


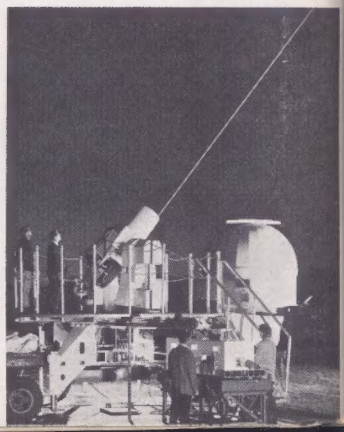
For a long time zoology books listed this tortoise as an extinct animal. All the while, it was crawling slowly around the Mexican desert, in full view of major highways. Worse still, people were feeding it. How had it escaped scientific notice? For the answer to this science adventure see p. 7.

Now a business can set up a teletype unit almost anywhere. All that is needed is an ordinary telephone and power supply, and a new mobile teletype terminal. See story, page 52.

Latest in a series of "individual mobility systems" is the Bell Pogo, which will transport two men through the air for several miles. See story on page 82 for details.

If you stand in the middle of a bamboo forest and listen you can actually hear the stuff growing. Find out more about this remarkable plant in the story on 37.



The next step in elementary education will be computers in the classroom. An RCA test project is already underway in a New York City school. The school computer is just one of the many things this month in "New For People", p. 62.

The laser, widely hailed as a space communications device, is now being put to the test by NASA. This laser beamed a light signal directly to an orbiting satellite. Read the details in the monthly round-up of developments in all fields of science on page 32.